AN EXAMINATION OF THE RELATIONSHIP OF ORAL AND WRITTEN REASONING ABILITY IN ELEMENTARY SCHOOL CHILDREN

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By

Otto Francis Fritze

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THE UNIVERSITY OF ALBERTA

AN EXAMINATION OF THE RELATIONSHIP OF ORAL AND WRITTEN REASONING ABILITY IN ELEMENTARY SCHOOL CHILDREN

A DISSERTATION

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

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ABSTRACT

This study was designed to discover whether variations in oral and written performance are associated with factors such as age, sex, intelligence and academic achievement, as well as with biological and sociological variables.

When oral and written performance are examined in the light of the 'operational thought' concepts of Piaget it appears that the upper end of the maturational scale is characterized by the superiority of the written over the oral technique. At the lower end of the scale, however, where oral experience precedes written experience by several years, the oral technique would be expected to dominate. Hence one is led to postulate a point of equidominance and a maturational movement away from the oral dominance of the early years to the written dominance of the adult years.

On the basis of the theory, a number of hypotheses were put forward for testing.

H_1: There exist sex differences in the O, W and O+W scores.

H_2: Oral performance (O) is to some extent different from written performance (W).

H_3: With advance in age and grade the reasoning activity involved in problem solving changes from a state of oral dominance in the direction of equidominance.

H_4: Since females are assumed to be more advanced in maturation, girls will tend to exhibit a greater progress away from oral dominance in the direction of equidominance.

H_5: The oral reports given by girls for correct solutions tend to be rated more highly than the oral reports for corresponding correct solutions given by boys.

H_6: Written as opposed to oral dominance is positively related to intelligence and achievement.

The experimental procedure required the individual testing of 301 grade four and grade five students in Burt's Reasoning Test. In addition, a wide variety of achievement and intelligence scores were available from the Clover Bar Survey.

Strong evidence was obtained in support of the first five hypotheses while the sixth appeared to be untenable, although the evidence in this case was far from conclusive.

Two findings emerged clearly from the thesis. All the evidence supported the hypothesis of a maturational movement from oral to written dominance, a movement in which the females maintained their initial advantage. At the same time the superiority of males in the oral reasoning, and to some extent in written problem solving, was evident. Both findings were seen to have important implications for the classroom.

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CHAPTER I

THE PROBLEM

In the elementary school oral activity precedes written work. Before grade three written language is fragmentary; yet, from this point on, there is usually a steady increase in the proportion of time devoted to written work as compared to oral performance. At all stages of a pupil's school life, however, he is appraised according to his proficiency in both oral and written work. Thus there seems to be an unstated assumption of similarity, almost of equivalence, between the two types of performance. Whether such an assumption is soundly based is a question to which a review of the available literature does not yield a ready answer.

The problem may be stated in other ways. Is oral performance different from written performance? Many teachers have asserted that this is so. "Johnnie can't express himself in writing;" "Mary can't think on her feet;" and so on. Do such differences exist? Are these differences permanent, or can they be overcome? Are there many Johnnies and Marys? Are such discrepancies found more frequently in certain grades, or at specific ages? Are there two distinct types of performance? If so, is one type more likely to be found in one sex than in the other? Do pupils of certain grades vary in the relative superiority of one type of performance over the other? Are Johnnie and Mary different from George, who as everyone knows, ". . . can get the answer but can't explain how he does it?" If such differences do exist, do they so appear

in other measurable performance such as achievement on academic or intelligence tests? Are there sociological, familial, economic or other factors associated with degrees of competence in each type of performance?

These questions suggest some of the many unsolved problems relating to oral and written verbal facility which are of vital importance to the classroom teacher. The first problem is whether the two facilities exist as separate abilities. Another is whether one ability is more prominent than the other in a given child. Is it also possible that a child may exhibit oral facility in one subject matter field and written facility in another field? Answers to these and comparable questions have not yet been reported in the available literature. The only studies of any relevance deal with the role of verbalization in problem solving. Fea (1953) compared the oral and written reports of what was remembered following the oral reading of several stories. Flanders (1948) recorded questions and oral comments made by pupils during seventeen hours of regular classroom instruction, and later classified them according to the level of operation. There are many other studies in which the subjects were instructed to "think aloud" as they solved problems in order to reveal methods of attack and causes of difficulty, error, or misunderstandings. None of the more than two hundred separate studies investigated provided adequate answers to the questions which have prompted this study.

Factual answers to the above questions could shed light on many of the problems in the present day classroom. If it were shown that oral

performance was more closely tied to intelligence and achievement, a fairer appraisal of pupil ability would be an evaluation of his oral performance. On the other hand, if written performance was demonstrated to be closely related to maturation, the emphasis on this activity might increase with age and grade. Various changes in pupil activity during learning might be desirable if answers to many of the above questions were available. The amount and quality of seatwork, for example, could be tied to the individual differences between pupils. If it were demonstrated that optimal performance is represented by equal oral and written performance, deficiencies in one of these areas could receive special attention. It is obvious that answers to the questions posed in this study could influence the work of teachers and pupils in many aspects of instruction and learning.

CHAPTER II

RELATED STUDIES

This chapter presents a review of the studies which seem to shed light upon the oral and written verbal activities involved in the reasoning performance of school children. While none presents evidence bearing directly on the present study, they do provide a background of insights of value in the planning of research into the relationships between the oral and written ability manifest in the reasoning of school children.

Meaning

The relation of language to meaning has been frequently investigated. Noble (1952) defined meaning as a purely empirical construct. Meanings were postulated to increase as a simple linear function of the number of S-multiple R connections established in an organism's history. In his experiment he presented a list of ninety-six dissyllables to a sample of U.S.A.F. recruits. By defining meaning in terms of mean frequency of written associations made within a sixty second time interval he developed a scale of M-values.

Holloway (1951), too, explored the meaning associated with verbal symbols and stated that while words acquired meanings through a process of conditioning, routine and chance could not account for intelligent behavior, and that action was intelligent to the extent that it was related to the purposes of the agent. The functions of language were

CHAPTER II

[illegible]

[illegible] provides a review of the [illegible] literature in [illegible] that deal with the [illegible] theme of [illegible] involved in the [illegible] of [illegible] [illegible]. [illegible] [illegible] [illegible]

purposive, and thus language constituted a systematic means of bringing about those results desired by the agent.

A third type of attack on the problem of meaning is that of Sherover (1954) who deals with remembering. To him, learning language involved learning and remembering certain patterns and forgetting some others; and it was the repeated exposure to the correct sounds of a language, uttered in meaningful contexts, which seemed to be most effective. He believed that the speech habits which constitute a language were best learned in wholes but did not recommend this method for analytic subjects such as mathematics.

Thorndike (1949) explored the creation of new meanings. He had his subjects write meanings for a number of difficult real words mixed with a dozen novel words constructed for the experiment. Invented or wrong meanings were highly specific, few being given by more than one individual. Most of the wrong responses exhibited a rational origin in that meaning became associated with parts of each word. He concluded that creations, in the brain or elsewhere, could be as truly determined as the formation of water by the union of oxygen and hydrogen.

An additional aspect of meaning was explored by Cunningham (1949) who raised the question as to whether vague language could be meaningful. He answered his own question by stating that since vague language was often the only functionally available language, vague language _qua_ vague must be said to be meaningful. He agreed that making language precise exhibited its meaning more clearly but insisted that this did not necessarily make it more meaningful.

An experiment having elements in common with each of the last two views is that of Campbell and Freeman (1955). Their purpose was to study the effects of experimentally induced language in perceptual learning--paired associate learning of a sequence of drawings. One hundred and two subjects were divided into three groups representing three conditions of language, while fifteen subjects formed a control group which did not have a learning trial prior to matching the pictures into the original pairs. The results suggested that (a) increasing the meaningfulness of visual stimuli facilitated learning if meaningfulness was relevant to the task, and (b) attention to crucial aspects of the stimuli aided learning. There was no support for the generalization that language in any form facilitated perceptual learning.

Verbal Behavior in Problem Solving

In studying the thought processes of children during problem solving Kato (1942) found that, in the search for patterns in unbroken tracings thoughtful solutions appeared with growth in perceptive ability, and that concrete thinking preceded abstract thinking. To explore the same topic Cofer (1951) performed a series of experiments which demonstrated that the amount of relevant verbal material available to a subject, its associative strength, and its value to him were all related to his ability to solve problems.

The value of graphical materials was investigated by Vernon (1952), who concluded that a written argument would not be made easier to understand and remember by presenting factual data graphically, except perhaps

in certain special circumstances. The most important special condition was that the readers had sufficient intelligence and experience to handle it.

According to Jorgensen (1954) all problem solving processes involve thought. While some problems could be solved by mere manipulation of real things, others required imagining or intending changes. This presupposed the use of symbols. In abstract thinking symbols seemed to be necessary; yet it was doubtful whether linguistic symbols formed necessary parts of the more concrete thinking of animals or small children or primitive people. A similar but more recent study of symbolism is that of Nesbit (1955) in such diverse spheres as the dream, myth, graphic art, history, politics, and mathematics. He concluded that God, nature, mind, matter and cause had as their referents large parts or aspects of reality as a whole, that they were part of reality, that reality was all that existed. Reality had two realms; one was that of physical things, the other was that of words, symbols, ideas and imaginings.

The study of symbolism has caused Kaldegg (1950) to postulate two types of language growth. Essays of children from grades three to eight on "My Vacation" were analysed with respect to abstract nouns referring to measures of time. The results apparently supported the idea of two types of language growth: external and quantitative as revealed in vocabulary counts, and the internal and qualitative aspect involved in symbolism.

Oral and Written Language

This section may well begin with the exemplary report of the measurement of understanding in the language arts as discussed by Greene and Gray (1946). They defined language arts broadly enough to include the written and oral expressional skills and the receptive skills of listening and reading. They gave suggestions for methods of evaluation designed to measure pupil accomplishment in terms of verbal behavior. They defined the purpose of instruction in expression as the development of the power to use language effectively in communication, whereas the aim of instruction in the receptive language arts was the cultivation of the ability to understand and react intelligently to all that the individual heard and read in customary life situations.

A slightly different approach was that of Carlton (1950) who studied substantive modifiers in the oral language of fourth and fifth grade children. In order to obtain a sample of the spontaneous every day speech of average children he selected a group having I.Q.'s ranging only from 90 to 110. The children looked at a series of pictures through a peep-show and told stories about the pictures which were taken down in shorthand. Approximately six per cent of the words used were substantive modifiers, but only 105 different substantive modifiers were used. These modifiers could be classified under seven types. There was no difference between the number of modifiers used by boys and girls; yet the girls used more descriptive modifiers which made their oral language superior in quality to that of the boys.

What are adaptive behaviors

[illegible]

The relationships between written and oral expression were investigated by Fea (1953). In his study three language samples were secured for each of 140 pupils in the fifth and sixth grades. These were the transcription of oral reading, the oral reproduction of what was read, and the written reproduction of the passage. Analysis of the records indicated that certain measures, including number of words, number of different words, and number of phrases, might be used as indicators of developmental level in all three cases, but that different norms were required for the different media. The level of development shown in the oral or written reproduction appeared to depend more on the level of material read than upon the reading level of the pupils.

A very similar study is that of Harwood (1955) entitled "Listen Ability and Read Ability." He stated that the principal purpose of the study was to investigate some relationships between written and spoken language of various levels of difficulty. Seven stories were constructed to represent each of seven different levels of reading comprehensibility. Each story was accompanied by a set of test questions about the information in it. All stories were presented orally to one group and visually to another group. The results were that the series of language samples was only insignificantly more comprehensible when presented for reading than when presented for listening.

Set

Research in the area of set has concentrated upon flexibility, rigidity, functional fixedness, and direction. The experimental

analysis of behavior during problem solving began with Maier's 1930 experiment on "direction." One problem involved constructing supports for a pendulum which made chalk marks on the floor. Another was the equally well-known Maier two-string problem in which the task was to tie together two strings supported from the ceiling but at such a distance apart that while one string was grasped the other was out of reach.

The question of whether set or rigidity is found in all problem solutions has been widely explored. In a study utilizing factor analysis Kleemeier and Dudek (1950) failed to reveal such a flexibility factor. Cattell and Tiner (1949) suggested three factors making for rigidity in problem solving in addition to low intelligence. Other factor analyses have yielded contradictory results. A brief listing will illustrate: Cowen, Wiener, and Hess (1953) reported ". . . a tendency toward a generalized mode of problem-solution has been demonstrated and the likelihood that this tendency is 'personality-related' strengthened" (p.102); Goldstein (1953) concluded "(a) it is difficult to maintain a concept of rigidity, even intellectual rigidity, as a unitary psychological trait, and (b) intellectual rigidity . . . is not a necessary concomitant of extreme or stable social attitudes" (p.352); Solomon (1952) found rigid and non-rigid groups (criticals) differed significantly in scores and tests of "ability to utilize the elements of the scientific method;" Pitcher and Stacey (1954) suggested that the more rigid in problem solving were more submissive; Wesley (1953) suggested that the rigid were slower than normal in forming new concepts. Sometimes rigidity was defined as a function of the atmosphere in which

the group worked, whether ego-involved, or relaxed and free. These and other experiments caused Brown (1953) to state that rigidity is, "a term which should always be written with an operational subscript." (p.469) The effect of atmosphere was indicated by Beier (1951) who showed that perceived threat, i.e., anxiety induced by unfavorable interpretation of Rorschach protocols, was followed by a "loss in flexibility of intellectual function and a disorientation of visual-motor coordinates" as measured by standard tests of vocabulary, abstract reasoning, concept formation, and mirror tracing. Difference in water jar solutions given by control, mild stress, and strong stress groups convinced Cowen (1952) that increasing degrees of experimentally induced psychological stress elicited increasing amounts of problem solving rigidity. In another study Cowen (1952) reported that the strong stress group revealed more rigidity than was found in a group in which stress had been reduced by praise. Similar findings were reported by Combs and Taylor (1952) who stated that the introduction of a mild degree of personal threat in the course of the solution of a simple task resulted in an increase of time needed to complete the task and in an increased number of errors.

Critical Thinking and Logical Reasoning

Morgan and Morgan (1953) found that performance on the Morgan Test of Logical Reasoning of a group with at least one semester of logic was superior to that of a matched control group. An increase of sixty-two per cent in performance by pupils taking a course in functional logic was noted by Melzer (1949). Somewhat contradictory results were achieved

by Brembeck (1949) who compared matched experimental and control groups in eleven colleges on a battery of four Watson-Glaser Tests of Critical Thinking, administered before and after a course in argumentation. Significant differences favored the control groups in some cases, the experimentals in others.

Sex Differences

In investigating sex differences on performance in problem solving, Moraes (1954) found the achievement of boys slightly superior, but only significantly so for one of the three age levels tested. Her data led her to suggest that girls reason as well as boys, but that they were either less quick or more careful; this suggestion was supported by Sweeney's finding that larger sex differences are obtained with shorter time limits. Using card tricks involving retention and transfer, Hilgard (1954) found the performance of boys to be superior to that of girls. Cofer (1951) found significant differences between men and women on the Maier two-string problem. Saugstad (1952) obtained a correlation between incidental memory and problem solving of -.41 ($P=.01$) for forty-nine high school boys, but of only -.10 for twenty-one girls.

Sweeney (1953) tried to determine whether sex differences could be demonstrated for groups equated for general intelligence, various special abilities, or specific knowledge or training. Significant differences favoring men were found in each of four tests of logical reasoning for 100 pairs matched in verbal aptitude scores. For 90 pairs matched in mathematical aptitude and for sixty-nine pairs matched both

in verbal and in mathematical aptitude, a difference was obtained only for scores in arithmetic reasoning. In two experiments in which subjects equated for intelligence and specific knowledge attempted the Alcuin problem, the men achieved a larger percentage of solutions (P=.005).

In an extremely elaborate experiment Sweeney (1953) matched sex groups for general intelligence, spatial ability, mechanical comprehension, and achievement in mathematics. On verbal tool problems, puzzle book problems, mathematic-logic problems, as well as Terman's Concept Mastery Test, Thurstone's Flag Test, an Abbreviated Mechanical Comprehension Test, and a Mathematics Achievement Test the males displayed significant superiority. In general the results supported the hypothesis that sex differences will occur in problems which involve difficulties in restructuring, but not in similar problems which involve no such difficulties.

Specific Factors Affecting Reasoning and Problem Solving

In reporting the results of a study of verbal behavior in reasoning, Cofer (1951) stated that the amount of relevant verbal material available to a subject, its associative strength, and its value to him were all related to his ability to solve problems. Reporting a study of the contributions of graphic representation to learning and problem solving, White (1953) suggested that all students could learn to represent situations, ideas, and emotions in a non-realistic, abstract form; and that such experiences might have a favorable influence on thought processes involving generalization. The effect of varying degrees

in verbal and in mathematical symbols, a difference was obtained only for scores in arithmetical reasoning. In two experiments in which [illegible] equated for intelligence [illegible] [illegible] groups, the [illegible] achieved a [illegible] [illegible].

In an extremely elaborate experiment, Bennett [illegible] groups for general intelligence, verbal ability, mechanical comprehen- sion, and achievement in mathematics. In [illegible] book problems, [illegible] problems, [illegible] [illegible] [illegible] mechanical comprehen- sion [illegible] statisti- cally significant. [illegible] the results [illegible] sex differences still occur in problems which involve difficulties in [illegible], but not in [illegible] culties.

Specific Factors Affecting Reasoning and Problem Solving

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of reality was explored by Lorge et al. (1955) in the Mined Road Problem. The subjects were members of the Air Force Reserve Officer Training Corps. The problem was presented in four settings, representing degrees of remoteness from reality; a verbal description, a photograph of the problem, a miniature scale problem with manipulation, and the real situation. The results were that no significant differences in quality of solutions were found; but written solutions presented by teams were always better than those presented by individuals.

Method of presentation and its possible effect upon solution was studied by Cobb and Brenneise (1952). Two hundred twenty-two college students were used in varied presentations of Maier's string problems. The authors found that the frequency of solutions depended upon the degree of abstractness of the problem setting, the material available to solve the problem, and the sex of the subject--men were significantly better than women.

Fattu, Kapos, and Mech (1954) investigated the relationship between the variables of age, sex, practice effects and anxiety on the one hand and certain response variables like error distance in solving mechanical problems and behavioral rigidity during trials on the other. The definite findings may be summarized: no general sex differences; no gains in problem solving from practice as such; an inverse relationship between anxiety and behavioral rigidity; and negative but complex relationship between age and problem solving.

In considering how children learn the principles and techniques of problem solving, Thorndike (1950) came to the conclusion that problem

solving was variable and complex behavior, consisting of integration of particular knowledge, skills and attitudes, but with no simple pattern or routine. He stated that the role of the school lies in helping the pupil acquire a wide range of interests and experiences, an organized and functional stock of background information, efficient skills for locating and organizing needed information, perseverance yet flexibility in attacking problem situations, a willingness to suspend judgment until the evidence is in, habits of testing critically any proposed solutions, attitudes of critical appraisal of the reliability and bias of sources, and finally, skill in "if-then" thinking.

In reporting the course of successful thinking, Lehner (1939) reported that for problems in which the more remote solutions were obscured by obvious facts, the process of solution showed that definition of the facts and trial and error behavior were characteristic of exploration, while definite insights were associated with successful solution.

After studying the behavior of good problem solvers, Fattu, Mech, and Kapos (1954) concluded that time might be a dubious criterion of problem solving efficiency; that a strong inverse relationship existed between magnitude of error and problem solving proficiency; and that the Miller-Frick index indicated that the poor problem solvers were consistently more stereotyped in their problem solving behavior than the good problem solvers.

Summary

The preceding studies by no means exhaust the list of experiments

which bear a resemblance to the present study. They do, however, shed some light on the relationship of the two types of verbalization which is the major concern of this investigation. In addition, they give the setting in which reasoning activity is placed. As used in this study, reasoning is one of the activities associated with the more general term problem solving.

Under the title "Meaning" were included studies illustrating meaning in language. Those studies of verbal behavior in problem solving were listed because of their close relationship to reasoning activities. Similarly research dealing with oral and written language was included. In order to illustrate how pupil performance on reasoning tests might have been influenced, the studies on rigidity were included. So also were those dealing with critical thinking and logical reasoning and studies dealing with specific areas of problem solving. It was discovered early in the present study that the sexes were performing differently and thus previous studies on sex differences in problem solving have been included.

Evaluation

This review of related studies reports no research directly comparable to the present study. It does, however, summarize earlier findings on which this study is based.

It deals with the following factors influencing reasoning and problem solving behavior:

1. The importance of meaning.

2. The role of verbal behavior and symbolism.

3. The relative importance of oral and written language.

4. The influence of set, rigidity and flexibility.

5. The place of critical thinking and logical reasoning.

6. Sex differences.

7. The complexity of the variables involved in this type of mental activity.

The planning and execution of the present study was influenced by the research in each of these areas. The fact that the earlier studies did not yield definitive answers to the problems which this study attempts to solve is, probably, its strongest justification.

1. The area of water covered by the [illegible].
2. The [illegible] [illegible] of [illegible] [illegible].
3. The [illegible] of [illegible], [illegible] the [illegible].
4. The [illegible] of [illegible] [illegible] [illegible] [illegible].
5. The [illegible].
6. The [illegible] of the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

The [illegible] [illegible] [illegible] of the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

CHAPTER III

THE RESEARCH PLAN: RATIONALE, DEFINITIONS, AND EXPERIMENTAL HYPOTHESES

The study of the relationship between oral and written performance in school activities requires an academic setting or orientation. After preliminary experimentation it was decided to use the solving of reasoning problems as the activity in which these types of performance could be studied. In particular, it was decided to employ Burt's Reasoning Test (Appendix A) with students drawn from grades four and five. To clarify the approach to the study, this chapter attempts to establish a rationale, to define the terms which will be employed, and to state the specific problems to which answers are sought.

Rationale

When we attempt to provide a theoretical basis for the discussion of differences between oral and written performance in the solution of reasoning problems, we are obliged to give some attention to developmental theories of intelligence and to consider in particular the theoretical position of Piaget.

Piaget postulates the existence of a maturational sequence which is characterized by an increasing ability to reason about situations independent of actual sensory contact. During the period of "informal operations," which Piaget confines to the age interval from 7 to 11 years,[1]

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[1]Recent experimenters, while supporting the hypothesis of a maturational sequence in logical operations, have disputed the validity of the concept of rigid age boundaries.

the child is able to reason only about situations which are immediately present, while in the later "formal operations" stage, there evolves the capacity to deal imaginatively with systems not actually present. At the same time the physical presence of the system being reasoned about renders the reasoning process easier even at the formal operations stage.

Translating into the language of this thesis, it would appear that there occurs a maturational increase in the capacity to reason orally (i.e., without such auxiliary aids as a pencil to draw diagrams or to otherwise reduce the complexity of the problem). However, the mature adult who can utilize the writing technique effectively renders mental problems easier through his ability to represent these problems in a manner which brings them closer to direct sensory contact. Thus the drawing of an adequate diagram dispenses with the necessity of retaining a complex configuration in memory, and writing down intermediate steps of a complex argument again reduces the memory load. There can be no question of the superiority of written over oral performance at the upper end of the maturational scale.

A somewhat more complex picture emerges at the lower end of the scale. In the first place, the child begins to speak several years before he begins to write, so that whatever logical behavior is exhibited in this period is of necessity oral rather than written. Consequently, oral performance must be superior to written performance in the earlier years. As the child matures, the ability to perform orally increases, but at the same time the child learns the mechanics of writing and the technique of employing written solutions in such a manner as to reduce

the mental effort required in the solving of problems. Consequently, somewhere between the oral superiority of the logical behavior of the earlier years and the written superiority of the later years we may expect to find a point at which the child is equally effective in the oral and written techniques. Thus as the child moves toward this point we could hypothesize the existence of a decrease in oral superiority and the gradual emergence of equal effectiveness.

The situation is further complicated by the assumed differential in maturational development between the sexes, and such sex differences as may exist in reasoning ability. Since it is usually contended that females are somewhat in advance of males with respect to the maturational sequence, we might expect that any cross-sectional sample, at a specific age or grade, would show the females to have made greater progress toward equal effectiveness in the oral and written techniques.

The discussion so far has dealt solely with what the student is able to do in terms of oral or written procedures, what we might term his logical output. There is the further question of the assessment of this output. In this respect, school situations may be roughly divided into two categories. In the first category are subjects such as mathematics where assessment of the logical product involves primarily a consideration of the correctness or incorrectness of the argument. In the second category, embracing such situations as essay writing, no absolute standard of right and wrong exists and assessment of the student's product is made on the basis of the judged adequacy of the arguments advanced. Since the female tends to possess a greater facility in the use of language, we

might expect that her verbal report of an argument would receive a higher assessment than that of a male with an equal logical grasp of the problem.

From this discussion emerge several experimental hypotheses which will be elaborated in the following sections.

Definition of Terms

(1) Oral Score (O). Oral score refers to the number of problems in Burt's Reasoning Test correctly solved by oral report by each pupil.

(2) Written Score (W). Written score refers to the number of problems correctly solved by written report by each pupil.

(3) Derived Scores. (a) Oral + Written, or O+W score refers to the sum of the correct oral and written scores for each pupil. (b) Oral-Written, or O-W score refers to the difference for each pupil when the written is subtracted from the oral score.

Subjects whose O scores exceed their W scores will be said to be orally dominant. Subjects whose O scores are equal to their W scores will be called equidominant. Subjects whose W scores exceed their O scores will be classified as written dominant students.

(4) Interviewer's Rating Score. Each answer, whether oral or written, was evaluated for adequacy on a five point scale. Adequacy is defined as the completeness of the report from the point of view of its thoroughness or adequacy in explaining the solution obtained. This rating was not completely determined by the correctness or incorrectness of the answer to the problem.

[illegible] and are varied under [illegible] of the [illegible] while [illegible] a [illegible] measurement [illegible] and of a [illegible] [illegible] [illegible]

Restatement of the Problem

To ensure clarity and to give direction to the experimental procedures, the problem has been divided into a series of subproblems expressed as hypotheses.

H_1 : There exist sex differences in the O, W and O+W scores.

H_2 : Oral performance (O) is to some extent different from written performance (W).

H_3 : With advance in age and grade the reasoning activity involved in problem solving changes from a state of oral dominance in the direction of equidominance.

H_4 : Since females are assumed to be more mature, they will tend to exhibit a greater progress away from oral dominance in the direction of equidominance.

H_5 : The oral reports given by girls for correct solutions tend to be rated more highly than the oral reports for corresponding correct solutions given by boys.

H_6 : Written as opposed to oral dominance is positively related to intelligence and achievement.

Implications of the Results

In order to clarify and to give direction to the future research procedures, the problem has been divided into a series of subproblems accompanied by hypotheses.

H_1 : There exists no difference in the α, β and γ waves.

H_2 : Total performance (P) is in some sense different than written performance (W).

H_3 : Only because of the fact that the operations involved in reading and writing differ from a priori expectations in the direction of equivalence.

H_4 : Since reading is a task to be more improved, then will tend to exhibit a greater frequency and more high coherence in the direction of equivalence.

H_5 : The dual response task is viable for several subtasks and so is more than simply the dual response for a corresponding unimodal stimulus plus a task.

H_6 : Writing as opposed to oral responses is qualitatively related to hemispheric and neurological.

CHAPTER IV

RESEARCH INSTRUMENTS AND ADMINISTRATION

The research instruments used in this study and the specific details governing their administration require some clarification. Burt's Reasoning Test was selected as being most suitable for the comparison of competence in oral and written verbalization of solutions to tests of reasoning. The Clover Bar Testing Program provided excellent data concerning the intelligence and achievement of the pupils in the experimental population.

Sample

It was decided to use pupils drawn from grades four and five as the experimental population. At this level, the mechanics of writing could be expected to be reasonably well mastered by all pupils. On the other hand, it was hoped that, in these grades, the imposition of formal statements and solutions in problems of Arithmetic and Science would not have structured or formalized greatly the nature of the pupil's oral or written responses. The sample was drawn from schools in the Clover Bar School Division because of the wide variety of data which would be available for the students arising out of the current Clover Bar School Survey reported by Black (1958). The grade four and five population of the three schools chosen, Ellerslie-Mill Creek, Campbellton, and Fort Saskatchewan, consisted of three hundred four pupils and comprised approximately half the grade four and five students of the school division.

CHAPTER VI

[illegible] AND RECOMMENDATIONS

[illegible] Interviews [illegible] to [illegible] [illegible] [illegible]

The Instruments and Data

It was decided to have each pupil work alone with the experimenter and alternately solve problems of similar difficulty with oral and written procedures. These problems were paired in order of ascending difficulty and were taken from Burt's Graded Reasoning Test, Short Form No. 29 (1922), which is included in Appendix A. After consultation with the classroom teachers prior to the study, the wording of the original items was changed slightly to make them more compatible with local language practice.

Burt's Reasoning Test

Burt's Reasoning Test (1922) consists of brief questions preceded by the data necessary for answering them. From the premises given the solution of each problem can be deduced by ordinary logical inference. No special knowledge is required apart from that which can be presumed common to all normal children at the ages tested. There are seventeen problems in all, the first of which is a practice problem and is used to familiarize the subjects with the type of question to follow. They are arranged in order of difficulty and allocated in groups to successive mental ages, two to each mental age level, from ages seven to fourteen years. Each problem is assigned to the age group at which fifty per cent of the children can successfully answer it. Age is taken as age at last birthday.

This test was chosen because there were two problems of equal

The Instruments and Data

[illegible]

Scale's Geometry Test

[illegible]

difficulty for each year, and thus one problem could be solved by oral explanation and the comparable problem by a written solution accompanied by a written statement of the method by which the solution was achieved. Very minor changes were made by substituting place names, objects, and activities more appropriate to the Canadian scene: "Jasper" for "Geneva," "mud" for "clay," "dime" for "sixpence," and "ball" for "cricket." The test was administered by having each pupil read each question aloud. He was then given the opportunity to ask about the meaning of any word or phrase. He was not told to solve a question by either procedure until the experimenter had reason to suppose that he understood all the facts which had been given. Thus the Reasoning Test permitted a record and a comparison of a pupil's proficiency in solving problems under the two procedures. Two separate scores, designated as oral scores and written scores, were achieved by adding the number of problems correctly solved by means of the oral and the written methods. An oral-written dominance score was obtained by subtracting the written score from the oral score.

The Observers' Rating Scale

The rating scale used in this study (Appendix B) was developed from the literature on problem solving. The survey of previous studies revealed that problem solving could be appraised according to "method," as was done by Burack (1950), or could be investigated through the difficulties met or the errors made, as was done in the experiments of Bloom and Broder (1950) and others. For this study the latter alternative was chosen as the one most likely to yield the type of informa-

tion sought. The rating scale is thus a check list of difficulties met or errors made. Refined through experimental use, it permitted the rating of both oral and written explanations of how the problem was solved as "excellent," "good," "fair," "below fair," and "poor." Each experimenter had ample training in the use of the rating scale prior to the study, and data relative to the reliability of the raters' use of the scale are presented in a later chapter.

Otis Intelligence Test

The Otis Quick Scoring Mental Ability Test (Beta) for grades four to nine was used in the Clover Bar School Testing Program, and its scores were incorporated in this study. These tests have the advantage, as claimed by the publisher, that the score is not materially affected by the amount or quality of reading skill of the pupil. The test is composed of multiple choice items graduated in difficulty from familiar and concrete to more abstract problems.

SCAT-STEP Tests

The tests used in the Clover Bar Testing Program were those of the SCAT-STEP Series. The School and College Ability Tests (SCAT) consist of two tests yielding three scores. SCAT Verbal is designed to measure ability to understand sentences and give the meaning of words--an ability closely related to school success in English, foreign languages, and Social Studies. SCAT Quantitative is designed to measure ability to perform operations with numbers and to solve mathematics

problems stated in words. This ability is closely connected with school success in mathematics and science. SCAT Total is a single score designed to give the best single prediction of general capacity to do the work of the next higher level of learning.

The Sequential Tests of Educational Progress (STEP) are a recently published series of achievement tests with a new approach. They are designed to measure critical skills through applications of learned principles and generalizations in six major academic areas including Mathematics, Science, Social Studies, Writing, Listening, and Reading. The Essay Test, which is part of the battery, is a standardized test of demonstrated writing skill and provides a score comparable to the other STEP tests. These are specifically designed to measure the ability of students to use what they have learned in the classroom in the solving of problems in the specified subject fields.

A major advantage of the SCAT-STEP series, particularly for their use in this study, was the fact that the converted scores on all tests permitted easy comparisons from test to test without further statistical treatment.

Clover Bar Survey Data

The last instrument was the Clover Bar School Survey Student Data Assembly Sheet (Appendix C). This sheet was filled in for each pupil by the classroom teacher. There were six major subdivisions of information thus supplied. The identifying data included name, age, sex, birthplace of pupil and parents, as well as languages spoken in the home. The

problem lasts 1 week. This action is already complete, [illegible]
[illegible] of [illegible] and [illegible]. [illegible]
[illegible] to [illegible] the [illegible] [illegible] or [illegible] [illegible] to
the [illegible] of the [illegible] level of [illegible].

[illegible] Tests of [illegible] [illegible] ([illegible]) are a [illegible]
by [illegible] [illegible] of [illegible] [illegible] [illegible] [illegible]. [illegible]
[illegible] to [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible], [illegible], [illegible] [illegible], [illegible], [illegible], [illegible] [illegible],
[illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible]

family section yielded information concerning parental and sibling membership in the home as well as the length of time the home had been in the present locality, and the ownership of home, car, or T.V. The educational data dealt with age of school entrance, school progress, school attendance, and whether the pupil had changed schools frequently. The economic division dealt with the occupation of the parents, location of place of employment, and financial return. The medical section covered features considered as having an influence on school performance, which, unlike the other information, was provided by the Leduc-Strathcona Health Unit. The final section permitted the rating of each of six prominent behavior characteristics on a five-point scale ranging from "slight" to "very marked." The characteristics were social participation, aggressiveness, honesty, truthfulness, cooperativeness, and emotional stability.

Test Administrators

The five test administrators who worked on this study shared common backgrounds in that all were former teachers. All had taught English, and two were former school principals. The fifth had been teaching until less than three months before this study began. Each had shared in the various phases of preparation for the testing program, in the choice of the Reasoning Test, the improvement of the rating scale and techniques of administration, and the various test trials of the scale. Procedures of administration and scoring were the results of much cooperative effort. Many sessions were devoted to securing

uniformity in use of the rating scale in order to permit precise classification of the oral and written reports. Little time was needed to decide upon any latitude of permissible variation in acceptable solutions. Tentative regulations were drawn up governing the initial motivation of each pupil and the maintenance of the necessary rapport. The extent of explanatory remarks by the experimenters, as well as all details of administration which could be foreseen, were tentatively defined. All were familiar with the objectives of the testing and the anticipated difficulties attending administration. The few additional questions which arose during the testing program were easily settled by group agreement as they came up. Each pupil solved problems alternately by oral and written report until the sixteen problems were solved or three consecutive failures had occurred.

CHAPTER V

RESEARCH DESIGN--PROCEDURES

The first step of the study was to secure an adequate sample. Through the kind cooperation of Mr. L. A. Walker, Superintendent of Clover Bar School Division, No. 13, the grade four and five classes of Ellerslie-Mill Creek, Campbellton, and Fort Saskatchewan were made available for testing. These schools furnished a sample of 304 pupils which included approximately fifty per cent of the total grade four and five population of the division. An explanatory letter was composed by the experimenter which was sent to all principals and teachers involved. Before the beginning of the testing period in the schools a personal visit was made to meet the principals and teachers in order to explain any features of administration which might temporarily interrupt classroom instruction.

Administration

Within the facilities provided in each school, the experimenters worked individually with each pupil. Preliminary plans for promoting rapport were very successful. On frequent occasions pupils voluntarily stayed during recess periods and after school to finish or even to start the work. Often they wished to continue trying to solve problems which their lack of success at previous levels had shown were beyond their ability. The experimenters made doubly clear that the pupil knew that his proficiency in oral and written reporting of how he solved each

problem was a primary objective of this study. He was also told that he could not be informed whether his solution was correct or incorrect, but that he would be stopped when it was certain that he had given a clear picture of his performance. While these explanations did little to reduce the confidence of the pupil who did well, it probably permitted the pupil who did less well to be less displeased with his achievement. Each of the experimenters was impressed by the sustained eagerness of every pupil to excel. As a consequence, the time spent with each pupil averaged between one and two hours. This time permitted maximum performance for every pupil, ranging from the correct solution of only one problem for five pupils to the other extreme where two pupils had correctly solved fifteen problems and one had solved the entire sixteen.

The order of administration was such that a pupil who reported orally how he worked out a given problem would next write out how he solved the succeeding problem. The first problem was a trial problem, permitting the experimenter to check on the degree of rapport established, the pupil's understanding of the directions which he had been given, and his understanding of the completeness of the explanations which were required. The succeeding problems were paired according to difficulty. Thus, questions two and three were at the seven year level of difficulty, questions four and five were at the eight year level, and, finally, questions sixteen and seventeen were at the fourteen year level. An illustrative order in which the problems were solved by a pupil would be question two with oral report on how the problem was solved, questions three and four with written report, questions five and six with oral

report, and so on.

The next pupil would solve question two with written report, questions three and four with oral report, questions five and six with written report. Thus, each question had as many potential oral solvers as written solvers. As each pupil worked orally on a problem the experimenter used the check list to maintain a record of that performance. In addition, comments were made concerning anything descriptive of a pupil's characteristic performance not covered by the check list. When a pupil finished the oral solution of a question his rating was recorded at once; evaluation of the written reports was completed later.

When a pupil worked on a problem involving a written report his performance was likewise checked on the check list, but appraised later as to quality. The correctness of the solution in both circumstances, however, was always marked immediately.

Thus, at the end of a pupil's problem solving session there was one descriptive sheet on his performance for each problem attempted. These sheets were used later in a qualitative analysis of problem solving performance.

Rating Consistency

Various means were employed to ensure consistency in the marking of the different experimenters. Besides certain preliminary precautions, there were checks on intra-tester and inter-tester consistency. These are discussed in turn.

(1) Preliminary Precautions. The precautionary measures taken to ensure

[illegible]

[illegible]

[illegible]

consistent marking included the following:

(a) The setting up of a definite rating scale to aid in assessment of problem solving performance.

(b) A review of this scale at the beginning of each day's testing.

(c) A preliminary trial run in which all testers took part.

(d) Periodic comparisons of the assessments of individual performances by all members of the testing team.

(e) The referring of unusual or unexpected problems of assessment to the judgment of the whole testing team.

(2) Intra-Tester Consistency. Periodically each tester reassessed individual performances which he had scored at an earlier period. In the case of verbal solutions, this was made possible through the use of tape recordings. Intra-class correlation coefficients (Haggard, 1958) between separate markings ranged from .70 to .90 and centred about .80. This would indicate that for each interviewer the ratings assigned to the same question on successive markings showed a very slight amount of variability. Thus it seemed to be a safe assumption that each experimenter maintained a consistent rating standard over the experimental period.

(3) Inter-Tester Consistency. A further important consideration is the consistency among the individual testers in rating individual performances. In this respect periodic remarkings of the performances of individual pupils in both oral and written solutions by all members of the group were undertaken. Intra-class correlation coefficients

[illegible] [illegible] the following:

(a) The [illegible] of [illegible] [illegible] [illegible] to [illegible] [illegible] of [illegible] [illegible] [illegible].

(b) [illegible] of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

(c) [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

(d) [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

again clustered about .80 indicating that the variability in the rating of individual questions by the separate interviewers was small.

In summary, it appeared that the formal rating sheet together with the precautionary methods employed resulted in a self consistency among the several testers and a consistency of rating between the interviewers which was adequate for the purposes of the experiment.

CHAPTER VI

ANALYSIS OF GROUP PERFORMANCE ON BURT'S REASONING TEST

The purpose of this chapter is an analysis of the scores on Burt's reasoning tests in order to test certain experimental hypotheses which were advanced in Chapter III.

H_1: There exist sex differences in the O, W and O+W scores.

H_3: With advance in age and grade the reasoning activity involved in problem solving changes from a state of oral dominance in the direction of equidominance.

H_4: Since females are assumed to be more mature, they will tend to exhibit a greater progress away from oral dominance in the direction of equidominance.

A further hypothesis was added for completeness:

H_7: There exist grade differences in mean O, W, O-W, and O+W scores.

Preliminary Statistical Analysis

(1) Distribution of Scores

Table I presents the distributions of raw O, W, and O+W scores as well as the distribution of the O-W scores increased by a constant of 10. The constant, added to simplify subsequent calculations, changed the O-W values from their initial range of -5 to +5 to a final range of +5 to +15. On the corrected distribution a score below 10 indicated that the written score of the student had exceeded his oral score, while a score above 10 indicated the superiority of the oral over the written score.

TABLE I

DISTRIBUTION OF ORAL, WRITTEN, O-W AND O+W SCORES

BY SEX OF TOTAL GROUP TESTED (N = 301)

	Oral (O)			Written (W)			(O - W) + 10			O + W		
Score	M	F	T*	M	F	T	M	F	T	M	F	T
16										1		1
15							1		1	1	1	2
14							3	2	5	1	2	3
13							7	8	15	4	3	7
12							16	10	26	7	7	14
11							35	37	72	11	8	19
10							35	49	84	11	14	25
9							27	40	67	14	23	37
8	3		3	2	1	3	9	9	18	19	21	40
7	7	5	12	3	5	8	5	3	8	18	26	44
6	22	15	37	16	17	33	1	3	4	14	17	31
5	17	32	49	20	23	43	1		1	18	17	35
4	27	41	68	30	48	78				6	11	17
3	33	39	72	33	29	62				8	6	14
2	18	18	36	21	24	45				4	3	7
1	10	7	17	14	13	27				3	2	5
0	3	4	7	1	1	2						
Total	140	161	301	140	161	301	140	161	301	140	161	301

*M-Male; F-Female; T-Total

TABLE [illegible]

[illegible]

[illegible]			[illegible]			[illegible]			[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]										[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]							[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(2) Tests of Normality

Two motives prompted the testing of the individual distributions on Table I for normality. In the first place, Burt's test purports to measure reasoning ability, a trait which one would expect to be normally distributed in the general population. Thus the normality or non-normality of the distributions is of interest in its own right. Moreover, many of the subsequent statistical tests assume that the variables involved are normally distributed.

When the test described by Walker and Lev (1950) was employed, the null hypothesis that the distribution does not depart from normality was rejected for all but one of the distributions at the .01 level. On the other hand, a study of the observed frequency distributions revealed that they tended to be platykurtic or leptokurtic rather than skewed and that the deviations from normality did not appear to be radical. Under these circumstances it was decided to treat the departure from normality as falling within the permissible range (Kenny and Keeping, 1951), and it was further decided to employ the more powerful t-tests to test significance of difference.

(3) Test of Significance of Mean Differences and Differences in Variability

Means and standard deviations were computed for the four variables O, W, O+W, O-W, and are presented in Table II.

The significance of mean differences and of differences in variability were made by employing t-tests.[1] The results may be summarized as

[1]The question of the strength of the scale provided by the reasoning variables (and the O-W variable in particular) is somewhat debatable. Parametric tests, which include the t-test, assume that the variables in question are measured on an interval or ratio scale. The general plan in this thesis was to employ parametric statistics as a first test for significant differences and to retest borderline cases using a non-parametric statistic. In the present case the Kolmogorov-Smirnov test (Siegel, 1956) was used to recheck the significance of mean differences.

TABLE II

MEANS AND STANDARD DEVIATION OF TEST SCORES

BY SEX AND GRADE (N=301)

Group	N	Oral Scores O		Written Scores W		Oral Dominance (O-W)+10		Total Reasoning Ability Score O + W	
		M.	S.D.	M.	S.D.	M.	S.D.	M.	S.D.
All	301	3.83	1.66	3.68	1.61	10.15	1.54	7.50	2.88
Males	140	3.88	1.81	3.63	1.65	10.24	1.64	7.50	3.08
Females	161	3.78	1.53	3.73	1.57	10.06	1.45	7.51	2.73
Gr. IV	164	3.47	1.60	3.25	1.49	10.20	1.56	6.71	2.64
Gr. V	137	4.26	1.62	4.20	1.60	10.10	1.54	8.44	2.88
Gr. IV Males	85	3.52	1.75	3.19	1.48	10.33	1.67	6.72	2.84
Females	79	3.38	1.39	3.27	1.47	10.12	1.54	6.66	2.41
Gr. V Males	55	4.31	1.74	4.20	1.60	10.11	1.68	8.51	2.96
Females	82	4.22	1.54	4.20	1.59	10.02	1.34	8.41	2.82

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follows:

(1) All grade five mean scores, oral, written, and combined (O+W), were significantly greater than the corresponding grade four scores at the .01 level of confidence.

(2) No significant differences were found between male and female mean scores for O, W, or O+W within either grade level. At the same time, the boys showed a slight superiority in oral scores at both grade levels while the girls showed a slight superiority in written scores at the grade four level.

(3) The grade four male O, O+W and O-W scores were significantly more variable (at the .05 level of confidence) than the corresponding grade four female scores. All other differences in variability were not significant.

(4) There were no significant differences in the O-W scores either between grades or between sexes.

The tests of the experimental hypothesis thus led to the acceptance of H_7, namely that grade differences exist between O, W, and O+W, and while the other hypotheses were not sustained at the .05 level, several supporting pieces of evidence were noted in the data.

(a) The grade four males were orally dominant to the extent that the difference between mean oral scores and mean written scores approached significance at the .05 level. At the same time the difference between mean oral and written scores for males at the grade five level was not significant and was appreciably smaller. Thus a movement toward equidominance is apparent here.

(b) A similar movement was observed for the females, who seemed to have almost attained equidominance by grade five.

Further Examination of Hypotheses H_3 and H_4

The significance tests provided some supporting evidence for hypotheses H_3 and H_4. A further study was made by dividing the population into equidominance ($|O-W| < 2$) and non-equidominance ($|O-W| \geq 2$) groups.

TABLE III

DISTRIBUTION OF EQUIDOMINANT AND NON-EQUIDOMINANT STUDENTS*

BY SEX AND BY GRADE (N=265)

	Number of Students in Equidominance Group	Number of Students in Non-equidominance Group
Grade Four Female	48	19
Grade Five Female	60	11
Grade Four Male	50	25
Grade Five Male	37	15

*The distribution here was that of the reduced sample for which complete data were available.

A further statistical analysis of the tabulated results employing χ^2 revealed the following results:

(1) The proportion of grade five students found in the equidominance group was significantly larger at the .05 level of confidence than the corresponding proportion of grade four students.

(2) This trend toward equidominance was found for both sexes, although the increase in the proportion of students in the equidominance group was significant for the females at the .05 level but not significant for the males.

(3) Some evidence was found for the hypothesis that females tend to be further advanced in the maturational trend toward equidominance. Not only did the females show a larger initial proportion in the equidominance group at the grade four level, but by grade five they showed a significantly greater proportion at the .05 level in the equidominance group than did the males.

In summary, it may be argued that sufficient evidence has been advanced to warrant a reasonable belief in the existence of a matura-

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tional trend toward equidominance, a movement which has progressed further for females than for males at the grades four and five levels. The hypothesis receives further attention in a later section, where a more rigorous approach is made through the use of groups matched in I.Q.

CHAPTER VII

THE RELATIONSHIP OF THE ORAL AND WRITTEN SCORES TO THE RATINGS OF PROBLEM SOLVING PERFORMANCE

Two kinds of measure of problem solving performance were employed in this thesis. The first yielded O and W scores which measured the number of problems solved orally or in writing in a battery of problems of increasing difficulty. The second score was not determined by the correctness or incorrectness of the answer but rather by the experimenter's assessment of the adequacy of the oral or written report of the solution.

The relationship between these two measures posed certain problems of theoretical and practical importance. One of these problems was raised in Chapter III, where we were led by theoretical considerations to suspect that the female's superior vocabulary and general facility in the use of language would allow her to display the logical products of her reasoning in a particular problem to greater advantage than a male who possessed an equal logical grasp of the problem.

The data allowed a tentative exploration of this important problem. The O and W scores can be taken as representing the logical 'level' at which the student operates; the rating scores represent the outward impression made by the student operating at this particular level. In this section three experimental hypotheses were put forward for testing:

H_5: The oral reports given by girls for correct solutions tend to be rated more highly than the oral reports for corresponding correct solutions given by boys.

CHAPTER VII

THE DEVELOPMENT OF THE CASE FOR PUBLIC SUPPORT OF THE ARTS: A SUMMARY OF PRESENT ACTIVITIES AND PROGRESS

The claim of members of creative activity professions were neglected in this country. The first phrase I use ¶ stress which emerged was number of problems which could, or in reality are a factor of particular difficulty. The second phrase was not determined by the activities or interests of the member but rather by the elements of society's assessment of the worth of the work or artistic means of the individual.

The relationship between these two dominant phase strands provides of theoretical and practical importance. One of these problems is called an chapter 1?, where we saw that in traditional institutions to support that the creative function individual and internal (social) is the key of changing social value but it limited the limited economic or the economics in a particular society is another particular that I will the institutional or legal limits. Some of the problem.

The case allowed a relative functionalism of this problem I mention. The 1 and 2 phases can be based on representative the national level as minor and general concern; the minor phase concerned the change representing some by the federal appointed as this particular level. In this section some international implications were not stressed for artists:

(1) The last phase (some by artist) is somewhat similar that is to mind some artist. Here the most phase the commercially artist and client seem to need.

H_8: The written reports given by boys and girls tend to be rated equally.

H_9: The oral and written reports given by grade five students for correct solutions tend to be rated more highly than the oral and written reports for corresponding correct solutions given by grade four students.

Procedure and Preliminary Analysis

Implicit in the definition and employment of the interviewers' rating scale is the assumption that its score is not identical with the O and W scores. In other words, it was assumed that the interviewers' scale score would not correlate perfectly with the right-wrong assessment of the answer. It is of interest to enquire to what extent the measures are correlated, since if the correlation approaches unity, the rating scale provides little new information.

In order to test this relationship, four questions were picked at random from the complete battery of 16 problems in Burt's Reasoning Test. For each question, the scores were dichotomized in two dimensions, (1) right or wrong, (2) a rating of fair or above, or a rating below fair. Phi-coefficients were calculated for each of the four questions and are reported in Table IV.

It is evident that for problems of easy or moderate difficulty the assessed quality of the reports of correct solutions is somewhat variable, while for difficult problems the quality rating of the reported solution is quite clear-cut (either excellent or poor).

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Conclusions and Recommendations Summary

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TABLE IV

THE RELATIONSHIP BETWEEN INTERVIEWER SCALE RATINGS AND O AND W SCORES FOR SOLUTIONS TO BURT'S REASONING TEST (GRADES FOUR AND FIVE)*

Problem Number	Percentage Passing	ϕ
2	94	.64
7	63	.64
13	9	.95
16	4	1.00

Testing H_5 and H_8

The five categories of the rating scale (poor, below fair, fair, good, and excellent) were assigned numerical ratings 1, 2, 3, 4, and 5 respectively. Median values were computed for the ratings given to the reports of solutions for problems correctly answered and are reported in Tables V and VI. Questions 13 and 16 were combined to give ratings for easy, moderately difficult, and difficult problems.

The significance of the difference between medians was tested in each case by the median test (Siegel, 1956), and the results may be summarized as follows:

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*Separate phi-coefficients were calculated for questions solved by the oral or written technique as well as for individual grades. Since no marked differences were found, the results were pooled to yield one coefficient for each question.

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[illegible]	[illegible]	[illegible]
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TABLE V

MEDIAN RATINGS OF ORAL REPORTS OF SOLUTIONS FOR PROBLEMS ANSWERED CORRECTLY FOR BOTH SEXES IN COMBINED GRADES FOUR AND FIVE

Problem	Median Rating Girls	Median Rating Boys	Difference
2	4.71 (N=80)	4.23 (N=60)	.48
7	3.89 (N=53)	4.05 (N=57)	-.26
13 and 16	4.33 (N=9)	4.80 (N=10)	-.47
Total	4.50 (N=142)	4.18 (N=129)	.32

TABLE VI

MEDIAN RATINGS OF WRITTEN REPORTS OF SOLUTIONS FOR PROBLEMS ANSWERED CORRECTLY FOR BOTH SEXES IN COMBINED GRADES FOUR AND FIVE

Problem	Median Rating Girls	Median Rating Boys	Difference
2	4.44	4.54	-.10
7	3.59	3.50	.09
13 and 16	4.00	4.69	-.69
Total	4.03	3.95	.08

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[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

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[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

(a) The hypothesis H_8 of no sex difference in the written reports is supported by the data. The median ratings of correct written solutions over the four problems were nearly equal for the males and females. For the difficult problems, the median interviewer ratings for males were noticeably higher than the median ratings for females, although the small numbers precluded the possibility of establishing significance.

(b) The hypothesis H_5 of a sex difference in the oral reports was rejected at the .05 level although the median interviewer ratings for the female oral solutions exceeded the median ratings of the male oral solutions, with the difference approaching significance at the .05 level. However, an interesting trend was observed in that while the female ratings were significantly higher than the male ratings for the easy problems ($P < .01$), the ratings shifted to the advantage of the males as the problems became more difficult. When the oral and written solutions were combined, the male ratings for correct solutions to the difficult problems were significantly higher than the corresponding female ratings with confidence at the .05 level.

(c) There was a tendency over the four problems to rate oral solutions higher than written solutions. The difference in ratings between oral and written solutions was significant at the .05 level for females and approached the .05 level for males.

Testing H_7

Table VII shows the overall ratings of the oral and written reports of the problems correctly answered for grades four and five.

(a) The hypothesis H_0 of no sex difference in the written solution is supported by the data. The median ratings of correct written solutions over the four problems were nearly equal for the males and females. For the difficult problems, the median interviewer ratings for males were relatively higher than the median ratings for females, although the small numbers precludes the possibility of establishing significance.

(b) The hypothesis H_0 of a sex difference in the oral reports was rejected at the .05 level although the median interviewer ratings for the female and solutions exceeded the median ratings of the male oral solutions, with the difference approaching significance at the .05 level. However, an interesting trend was observed in that while the female ratings were significantly higher than the male ratings for the easy problems (1 & 2), the ratings shifted in the assistance of the male as the problems became more difficult. When the easy and written solutions were combined, the male ratings for correct solutions to the difficult problems were significantly higher than the corresponding female ratings with confidence at the .05 level.

(c) There was a tendency over the four problems to have oral solutions higher than written solutions. The difference in ratings between oral and written solutions was significant at the .05 level for females and approached the .05 level for males.

Testing H_0

Table VII shows the overall ratings of the oral and written reports of the problems correctly assessed for general fear and fits.

TABLE VII

MEDIAN RATINGS OF WRITTEN REPORTS FOR PROBLEMS ANSWERED CORRECTLY, ORAL AND WRITTEN, GRADES FOUR AND FIVE

	O	W
Grade 4	4.14	3.48
Grade 5	4.51	4.38

Application of the median test revealed the following results:

(a) The increase in the median rating of oral reports between grade four and grade five just failed to reach significance at the .05 level.

(b) The increase in the median rating of written reports between grades four and five was significant beyond the .01 level.

(c) The difference between median ratings for oral and written reports is significant at the grade four level ($P < .01$) but is not significant at the grade five level. The movement toward equal ratings seemed to parallel the maturational movement toward equidominance which was observed in the previous chapter.

Summary

In this chapter we have examined further the relationship between the O and W scores and the assessments of the solution of problems correctly answered. The O and W scores represent the subject's ability

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with the oral or written techniques; the latter score represents the subject's effectiveness in showing the adequacy of his argument.

A series of phi-coefficients indicated that over the whole population, the interviewers' assessments of the reports of solutions of difficult problems which were correctly answered, using either the oral or written report, were invariably high, while the assessments for the easier problems showed considerable variability. In addition, the females showed a significant superiority in the ability to present their oral solutions effectively; a superiority which could be linked, in theory, with their supposed superior facility in language usage. As the problems become more difficult, this verbal 'halo'--which was apparently superimposed on the logical framework of the solution--broke down, and the males received higher assessments at this level for both oral and written arguments.

A further comparison of median assessments of both grades indicated a maturational movement which paralleled that previously observed for the O and W scores. For not only were the grade five assessments for oral and written solutions significantly higher than the corresponding grade four assessments, but the movement toward the equality of oral and written assessments was also found.

This chapter is offered as a preliminary introduction to what appears to be a very important problem. For the existence of sex and maturational differences in the ability to present logical arguments effectively has many implications for school and real life situations in which one cannot judge logical behavior against a right-wrong

dichotomy but must fall back upon the assessment of the adequacy of the arguments presented.

CHAPTER VIII

QUALITATIVE ANALYSIS OF PERFORMANCES ON BURT'S REASONING TEST

This chapter seeks to examine in greater detail the reasoning performance of groups of students displaying different patterns of verbal dominance as revealed in the comments and ratings of the experimenters.

It is recalled from the preceding chapters that the performance of each student for each item was rated on a special form. A typical rating form for one such item is presented in Appendix B. It will be noted that besides the indication of the correctness of the response the form provides for an evaluation on a five-point scale of the student's overall performance on this particular item and allows space for comments by the experimenter.

This chapter will attempt a preliminary examination of the distribution of verbal dominance scores as presented in Figure 1. The examination will also review the evidence concerning each pupil recorded by the interviewers when the reasoning tests were administered. The subsequent chapter will attempt a statistical analysis of the data.

Graphical Distribution of Verbal Dominance Scores

It was reasoned that a student with an oral score of seven and a written score of five which yielded a verbal dominance score of twelve (O - W + 10) presented a completely different picture than a student who had an oral score of two and a written score of zero. Consequently each

Oral Scores										
	8				1				1	1
D	7				2		2	5	2	1
	6			1	4	8	11	10	2	1
	5		2	6	8	15	9	7	2	
C	4		5	5	14	25	13	6		
	3		3	15	20	23	6	5		
B	2		8	11	13	2	1		1	
	1	2	6	6		2	1			
A	0		3	1		3				
		0	1	2	3	4	5	6	7	8
		a		b		c		d		

Written Scores

FIGURE I

DISTRIBUTION OF ORAL AND WRITTEN SCORES BY CELLS

score was located on a grid with ascending oral scores on one axis and written scores on the other. This device permits graphical representation of each pupil's reasoning performance in terms of oral and written score and the relationship existing between the two. This distribution of scores is presented in Figure 1.

The oral and written scores ranged from zero to eight permitting development of a grid of nine horizontal and nine vertical lines enclosing eighty-one cells. For convenience these cells were regrouped into cells four times as large, beginning at the origin. The four enlarged cells in the vertical or oral axis were labelled A, B, C, and D; the corresponding cells on the horizontal or written axis were designated a, b, c, and d.

The cell identifying low oral coupled with low written performance is cell Aa, whereas the cell representing superior performance in both categories is Dd. A cell with an extremely good oral performance but with a poor written score is Da, and so throughout the diagram. The figure contains a total of sixteen "cells" or categories indicating varying degrees of relationship of oral or written dominance. To permit the qualitative analysis of problem solving behavior, a random sample of ten students was selected from each cell for further study. Where less than ten subjects fell in a cell, all cases were used.

Qualitative Analysis of Cells

A qualitative analysis was made of the reported problem solving behavior of the pupils in each of the sixteen cells in order to deter-

[illegible] the loading on a pile with relatively small movement on the pile and [illegible] on the shaft. This design service [illegible] [illegible] of this point's [illegible] [illegible] to [illegible] of [illegible] [illegible] [illegible]

mine characteristic features of similarity and difference. When each cell was examined in detail, surprisingly few common characteristics were found. In order to accentuate any points of comparison the cells were combined in two ways. First, those cells, in which oral and written performance were approximately equal, were subjected to careful study. The cells involved are Aa, Bb, Cc, and Dd and represent a continuum of increasing efficiency in problem solving in which the pupils are roughly equal in oral and written reasoning scores. Second, a contrast was made of the two cells, Ca and Db, which showed the largest oral dominance with the two cells, Ac and Bd, which revealed marked written dominance. In the interest of clarity the two comparisons will be restated. First, what points of similarity or difference characterize the four cells which constitute the progressively improving continuum of reasoning capacity and in which oral and written dominance are relatively equal? Second, what points of similarity or difference are evident when the cells which reveal marked oral dominance and written dominance are compared?

Cells of Equal Oral and Written Performance

Cell Aa comprised scores for eleven pupils falling into the following patterns: Oral 0, Written 0; Oral 0, Written 1; Oral 1, Written 0, Oral 1, Written 1. There were eleven cases falling in this cell of which ten were randomly drawn for detailed description.

The oral and written reports on cell Aa showed that of all problem solutions reported by the entire group, only three received a

mark of "excellent," and three of "below fair." In such cases the examiner's comments stressed "slow reading," "poor reading ability," "reads laboriously," "seems unable to read for comprehension," and similar phrases. The written reports were characterized by such comments as "too short," "careless," "can't explain," "sentences are broken," and "expression, whether oral or written, seems an effort." The group was also considered as "unable to grasp this problem," "unable to visualize problem," "unable to deal with all parts of the problem," and similar criticisms. In the problem whose correct answer was "Jasper," the answer given several times was "I will go to Hawaii because I like Hawaii." Yet the problem related to where a friend should go under certain conditions. On the occasions where diagrams might have been an assistance in solutions, detailed pictures were sometimes drawn.

Cell Bb comprised the scores for fifty-nine pupils which fell into the following patterns of oral and written achievement: 2,2; 2,3; 3,2; 3,3. Of the sixty-two scores, ten cases were randomly selected. Since the range in I.Q. points in this group was from 79 to 127, it was difficult to make observations that refer to the complete group. Poor reading was a general cause of poor answers, as witness the examiners' comments of: "read stumbling several times," and "question whether he understands what he reads." Another feature which came out even more generally was the factor of uncertainty; for example, there were many comments such as these: "rereads, but is flighty," "too quick; changes answers often," "very nervous, lacks confidence," "slow, then not sure of answer," "guesses, rather than works out . . . quits too easily," and

"may not be able to keep ideas in mind." There was a common logical difficulty that appeared to be indicated also in such comments as "disregards facts that didn't appear easy to incorporate," "often shifts to 'some' facts related to own experience," "can't see problem apart from himself," "with harder problems, uses own experiences," "relies on own experience," "considers only 'part' of what was given," "rarely gives a full explanation."

The quality of the reports marked by the examiners showed a distribution of ratings which differentiated between this group and the group already studied. If we disregard ratings for each pupil on problems the pupil couldn't do, we find that the ratings "excellent," "good," "fair," "below fair," and "poor" occurred in almost equal proportions for the cell as a whole.

Cell Cc comprised scores of oral and written achievement of 4,4; 4,5; 5,4; 5,5; and was the largest, numerically, of all cells having sixty-two cases from which the selection was made. The average number of problems solved correctly by this group was 8.7. This was above the total group average of 7.8. This group was thus slightly above average in number of correctly solved problems and almost equal in the number of problems solved with oral report and written report.

The supplementary comments again failed to indicate clearly defined common attributes. The brightest and the dullest pupils in the group did have some similarity. Some of the comments on the brightest were, "nervous, false starts, omits too much;" critical comments included, "changes mind too often, uses diagrams but lacks confidence."

The examiners' comments appeared to deal with two common aspects of the cell population. First, they seemed to praise good work, and, second, they appeared to describe clearly a common weakness in performance. Illustrations were: "careful logic, usually illustrated or diagrammed," "beautiful argument, yet occasionally misses a 'part' that was given," "good, but too short, thus a part is omitted," "very fluent, but omits what should be said," "incomplete too often; could have explained more." A final comment has been met in previous sections, "when stuck he substitutes his own experience for something similar."

Cell Dd comprising scores of 6,6; 6,7; 7,6; 7,7, is composed of scores of individuals found in row 6 column 6 and row 7 column 7. (See Figure I.) To avoid omission of children whose scores fell in row 8 column 8, cell Dd was enlarged, bringing its total to twenty-three rather than nineteen cases. From this total a sample of ten was drawn for further study.

The quality of the oral and written answers was generally very good. From a total of 160 answers ninety-one were marked "excellent," twenty-seven marked "above average," eleven marked "average," nine "below average," and twenty-two were marked as "poor." The supplementary comments of the examiners revealed considerable diversity. There was general agreement that diagrams were used very effectively and that the elimination of extraneous or incorrect possibilities was very adequately done. Reading was commented on with such phrases as "quick reader," "slow careful reader," "indicates quick understanding." Writing received the comments "very slow writer," "good penmanship," "writing is rapid,

uses language fluently," "beautiful composition," "speaks ungrammatically, writes well." The quality of logic exhibited drew frequent comment, for example, "clear thinker," "systematic," "logical in excluding wrong possibilities," "clear explanations," "exact treatment," "eliminates each in turn," and similar phrases.

Summary

This section attempted to discover the trend of student performance in the continuum of four cells: Aa, Bb, Cc, and Dd, in each of which oral and written performance was relatively equal for each pupil, and in which from cell to cell reasoning scores steadily improved. It has sought to determine the relationship of each student's actual score to the examiners' evaluation of his problem solving behavior on the reasoning test. The quantitative performance expressed as a relationship of oral to written scores had been used to group students for analysis in Figure I.

For students whose oral performance was approximately equal to their written performance, i.e., their scores indicated no definite "oral or written dominance" in problem solving, the expected improvement from the low performance to high performance groups was reflected in the examiners' ratings of the "quality of problem solving." The examiners' supplemental comments on the rating form seemed to suggest steady improvement in efficiency on the part of successful problem solvers while the unanimous comment on the poor problem solving group was "poor reading ability" and "reading without meaning." The examiners usually didn't

specify the particular reading difficulty. Speed of reading was apparently not a factor as both slow reading and rapid reading were associated with both successful and unsuccessful solutions in each cell.

Logical treatment of the problem seemed to occupy space in all reports. The examiners' comments suggest steady improvement in logic through the sequence of cells from Aa to Dd. When a single reading did not suggest a solution, pupils reread--perhaps made a diagram or illustration, or in some cases a list, so that extraneous items could be eliminated. If the difficulty were more severe the rereading was more frequent until, finally, a decision apparently was reached to disregard facts that could not be made to fit. Thus, the solution evolved was usually incorrect or partial. An even more difficult problem produced continuous rereading until some one apparently familiar fact stood out and all others were disregarded. The most difficult problem of all appeared to produce the result that some fact in the problem called to mind a similar fact from experience, which then was used as if it had been included in the original problem.

The above summary, which attempts to evaluate performance along the continuum of cells Aa, Bb, Cc, and Dd as reported by the experimenters, may be rephrased as follows:

1. There was steady improvement in quality of performance from cell Aa to cell Dd.
2. In the lower cells the mechanics of reading were poor, and reading without meaning resulted.
3. The quality of logic exhibited improved steadily from

cell Aa to cell Dd.

Cells of Unequal Oral and Written Performance

The next aspect of analysis attempts to find similarities or contrasts between the cells showing greatest dissimilarity in oral and written performance. Two cells, Ca and Db, comprise the cases where oral performance markedly exceeds written performance, while the two cells, Ac and Bd, include the cases where the reverse situation prevails. A detailed analysis of these cells follows.

Cell Ca contained scores of 4,0; 4,1; 5,0; 5,1. No scores were either 4,0 or 5,0; yet seven were either 4,1 or 5,1. The quality of the verbal reports was not considered to be high in this cell. To slightly less than one-quarter of the reports did the examiners give values of "excellent" or "good." The oral work received this rating more frequently than the written work in the ratio of 15:4. A slightly smaller per cent of the oral reports received marks of "fair" and "below fair," and the ratio of the marks for oral and written work was again in favor of the oral work, being 11:5. That is, an oral report was more than twice as likely to receive these marks as the written report.

Comments of the examiners yielded a common criticism of attitude toward the problem at hand. Representative ones were,"unsure, rereads often," "casual attitude, sure her methods are correct," "a tendency to guess, to make false starts," "too brief; thinks this is desirable . . . hurries and makes mistakes," "tried to out-wait the examiner for clues, etc. . . . seemed to guess a lot." There were the usual criticisms of

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The core element of analogy involves an [illegible] of [illegible] between two [illegible] [illegible] [illegible]

poor logic and failure to include or consider pertinent facts. However, the examiners apparently felt that the pertinent factor was an attitude of uncertainty and devoted little criticism to other characteristics.

Cell Db comprised such scores as 6,2; 6,3; 7,2; 7,3; and the single score of 8,3. There were eight cases in this cell. These cases indicated quite good performance with oral report and noticeably poorer performance with written report.

In this group the examiners appeared reluctant to give "excellent" to either the oral or written reports. While the pupils had correctly solved over sixty per cent of all the problems on the test, in less than one-sixth of the reports was an "excellent" mark given by the examiner. Out of almost eighty reports twenty-one oral reports and only one written report received this rating. The "good" rating was given to approximately twenty-two per cent of the reports with eighteen oral and ten written reports receiving this grading. Similarly the intermediate rating of "fair" was given to less than seven per cent of all reports. The general pattern was to rate the report either "excellent" or "good" on the one hand and "poor" on the other. No other cell group showed the same dichotomous characteristic.

A careful perusal of the examiners' supplementary comments stresses this "all or none" tendency but fails to reveal contributing causes or explanatory descriptions of distinctive behavior for this cell. When the pupils made "excellent" or "good" reports it was apparently for the same reasons that have been previously noted for other cell groups. When they failed to do so, the causes were again the common

causes repeatedly referred to above.

In summary, it may be stated that the examiners' rating in each of the orally dominant cells, Ca and Db, indicated two common characteristics:

1. The quality of the report was often poor regardless of whether the report was correct or incorrect.
2. Uncertainty in attack was a common criticism of the pupils in these two cells.

When attention was turned to the written dominant cells, viz. Ac and Bd, cell Ac comprised the group which did extremely poorly on oral work and better on problems with written report. Typical scores were 0,4; 0,5; 1,4; and 1,5; with the oral scores in each pair being mentioned before the written scores. Only six pupils had such scores.

Descriptions of this group were doubly difficult. First, the group comprised but six members; and second, the group appeared to contain two separate types. One type made up of two individuals had a definitely higher I.Q. rating than the average for the rest of the cell group, being 114 and 140 I.Q. points; yet few, if any, of the twelve scores on the testing program were superior to the cell average. Their work was marked by the examiners as either "excellent" or "poor," with intermediate rankings completely absent for the brighter pupil, and almost completely so for the other. The brighter pupil repeatedly drew from the examiner an abrupt comment relative to the omission of important facts in the given problem. One of the concluding statements of the examiner was "very good" or "very bad." In each case the latter rating

[illegible] physically restrictive to [illegible].

In theory, it can be shown that the conditions [illegible] in the social [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]:

1. The [illegible] of the [illegible] are [illegible] [illegible] [illegible] [illegible] [illegible]

was due to the complete disregard of an important aspect of the problem. The other pupil was also reported as "doesn't always read with meaning." The fact that emotional as well as poor reading factors may be involved is found in "good diagrams, but oh, so hesitant."

But these comments give no clue as to why, when solving a problem with oral report, a pupil of I.Q. 140 should fail to get a single correct answer, yet when solving an almost identical problem with written report, should each time get the correct answer as well as make an "excellent" rating on the description of how it was solved. A further analysis of the ratings of the verbal performance and the supplementary comments of the examiners shows that none of the remaining pupils received a rating of "excellent." Repeatedly the correct answer was accompanied by a "poor" report. Comments were "apparently can't keep details in mind," "quick but superficial," "reads one word at a time, considers 'part' only," "goes over and over the same explanation, or gives an answer and no explanation." In three cases the poorer pupils were reported as having "poor attitude," "hesitant," "when in difficulty substitutes self for person involved."

Cell Bd comprised the typical scores 2,6; 2,7; 3,6; and 3,7; and included six cases. These pupils did much better with written report, in one case getting two problems correct with oral report and seven correct with written report. Few "excellent" gradings were given to either written or oral reports. The written reports received a "good" rating in the ratio of 16 to 3 when compared to the oral reports. In a similar manner the mark of "fair" was given to written and oral reports

in the ratio of 11 to 1. As marked by the examiners the quality of the written reports was thus considered superior to the oral reports.

The supplementary comments of the examiners were almost unanimous in their reference to the efficient use of diagrams. Since the examiners were not likely to be aware that more problems were being solved with written report than by oral report, no reference to the reason for this difference was included. Another general comment related to efficient rereading. There were the usual comments regarding incomplete explanations, explanations based upon "part" of the given problem, and instances of identification of the pupil and problem. Effort was commented on for every pupil. There were phrases like "such a tremendous effort," "tries so hard," "very eager to cooperate." At present there seems no reason why this should influence written report to a greater extent than oral report.

The examiners' comments of the above two cells of written dominance indicate two salient features:

1. "Excellent" or "good" ratings were seldom given.
2. An attitude of uncertainty in the pupils characterized the reasoning performance.

When the two groups, Ca and Db, of greater oral problem solving success were compared with the two groups, Ac and Bd, of greater written problem solving ability, it was noticed that features of similarity stood out. The first of these is that of attitude. For both cell Ca and cell Ac there was the common statement by the experimenters of insecure attitude while problem solving. Cell Bd students seemed to impress the

examiners strongly with their desire to do well, to please, and to co-operate.

The ratings of both oral and written reports for the cells Ca and Ac were again similar. In very few cases were "excellent" or "good" ratings given. In nearly all cases the experimenters considered that the logic exhibited was very weak, in spite of the correct solutions achieved thereby.

Cells Db and Bd, of slightly better performance, were also similar to the previous two cells as regards attitude, logic exhibited in both oral and written reports, and ratings received. In spite of success in solving problems, the pupils appeared uncertain and the quality of their oral and written reports indicated a hesitancy in expression. There was evidence of understanding in the efficient diagrams developed, but expressions of logic were otherwise poor. It is thereby concluded that where differences in oral and written problem solving ability exist, they are accompanied by feelings of uncertainty frequently taking the form of a tendency to guess. As a consequence the reasons given for a solution are generally fragmentary or incorrect.

Summary

A brief recapitulation of the comparison of performance in cells of equal oral and written dominance follows:

1. There was a steady improvement in quality of performance and quality of ratings of both types of verbal report from the poorest to the best.

2. There was a progression from poor reading in the lowest cells to efficient reading in the highest cells.

3. A similar improvement in the quality of logic exhibited was revealed from the lowest cell Aa to the highest cell Dd.

The cells of unequal oral and written dominance yielded two outstanding similarities and no outstanding dissimilarities.

1. In all cells, high ratings were infrequently given by the examiners.

2. A common attitude of uncertainty, perhaps a tendency to guess, was exhibited in each of the four cells.

CHAPTER IX

THE RELATIONSHIP OF ACHIEVEMENT PERFORMANCE ON THE CLOVER BAR TESTING PROGRAM TO PERFORMANCE ON BURT'S REASONING TESTS

In this chapter three distinct and separate studies were made of the relationship between performance on Burt's Reasoning Test and tests of intelligence and achievement included in the Clover Bar Testing Program. Again the data were organized on the axes of oral and written dominance employed in Figure 1 in the previous chapter which permitted the quantitative comparison of cells representing groups of pupils of varying degrees of oral and written dominance.

The four problems to be studied included:

1. A general exploration of the relationships existing between reasoning scores and scores on the Clover Bar Testing Program.
2. A study of the intelligence and achievement of the four levels of equal oral and written dominance on the continuum of reasoning scores.
3. A comparison of the intelligence and achievement of the markedly orally dominant and the markedly written dominant groups.

A General Evaluation of the Relationship Between Reasoning Scores and Scores of Intelligence and Achievement

At this stage a comparison was made of pupil performance on Burt's

Reasoning Tests and achievement on the Clover Bar Testing Program variables. Since in Figure 1 in the preceding chapter a pupil's oral and written scores had already assigned him to a cell location indicative of his oral and written performance, the procedure was to compute the mean performance of all pupils within each cell on each of the Clover Bar Testing Program variables. The next step was to discover whether such means differed from the total group means on each variable. It was noted that two cells indicating extremely poor oral and good written performance (Ad) and good oral and poor written performance (Da) had no cases. The data are reported in Table VIII.

In the above table oral performance holds constant in the first four rows, while written performance has improved from row to row. In the next four rows oral performance has again held constant at a higher level, while written performance has varied. A similar pattern has been observed in the remainder of the table. If performance is divided so that rows 2 to 9 refer to low oral performance and rows 10-17 refer to high oral performance, certain relationships become more apparent. It is obvious that chronological age does not appear to be a dominant factor in performance. When the I.Q. column is referred to it is apparent that every mean of the low oral performing group is below the total group mean, while only one mean of the high oral performing group is similarly below the average of the total group.

An almost identical picture is revealed for the three SCAT scores. The low performing oral group is usually below the total mean while the high performing oral group is above the total mean. There is of course

TABLE VIII

MEAN PERFORMANCES FOR TOTAL GROUP AND FOR CELLS OF VARYING ORAL DOMINANCES

				SCAT			STEP						
Group	N	C.A.	I.Q.	V.	Q.	T.	Math.	Sci.	S.S.	W	L	E	R
Total	265	124.4	111.6	251.9	261.7	259.5	250.4	257.9	249.6	263.1	270.7	272.7	263.5
Cell Aa	11	131.3	94.1**	241.5**	253.5**	251.6**	238.7**	246.9**	236.9**	251.8**	257.7**	261.4**	247.4**
Ab	7	126.3	98.3**	241.4**	249.8**	250.0**	235.9**	242.8**	237.4**	245.0**	251.7**	256.0**	244.7**
Ac	6	128.0	106.0	249.3	262.0	257.7	245.3	255.5	248.5	259.0	270.0	268.3	257.5
Ad	0												
Ba	11	123.1	110.4	246.4*	257.6*	255.1**	246.2	255.3	241.2**	252.3**	263.1**	272.5	254.7**
Bb	51	128.8*	99.6**	245.8**	255.4**	253.9**	246.1**	251.3**	245.4**	250.1*	265.1**	267.8**	253.6**
Bc	28	124.8	111.2	253.3	260.9	259.5	246.8**	258.9	248.1	257.5*	271.3	268.9	262.2
Bd	6	124.7	101.3**	250.0	262.2	259.0	251.6	256.2	249.2	252.0**	268.0	257.0**	253.4**
Ca	7	124.7	100.0**	243.7**	251.8**	251.8**	242.2**	245.7**	245.2*	245.7**	258.8**	268.3	251.2**
Cb	27	119.5**	111.6	251.9	255.9**	256.5**	247.1*	257.8	252.1	256.9**	268.9	265.0**	256.1**
Cc	52	121.0*	117.8**	251.2	260.2	258.3	253.3*	259.7	253.2**	264.9	272.0	276.3**	267.0**
Cd	13	126.1	117.8*	258.2*	270.0**	266.6**	256.9**	266.9**	257.5**	267.9*	278.4**	273.8	271.0**
Da	0												
Db	8	121.3*	114.1	253.4	257.0**	257.3	249.6	258.5	245.9	261.9	273.3	271.1	265.5
Dc	18	121.8	122.1**	263.9**	267.1*	266.6**	257.9**	265.5**	256.4**	267.7	278.7**	272.2	265.2
Dd	20	131.5**	119.3**	269.0**	275.3**	273.8**	261.8**	267.9**	262.0**	279.7**	286.9**	276.3	281.3**

**Indicates a difference between cell mean and the group mean significant at .01 level.

*Difference is significant at the .05 level.

a general increase in SCAT scores and I.Q. scores which accompanies improvement in good oral and written performance.

Similar comparisons are revealed when the three STEP scores on Mathematics, Science, and Social Studies are compared to the three SCAT scores just mentioned. On a numerical basis the low performing oral group contains ten cell means which are significantly lower at the .01 level than the total mean, while the three STEP scores contain eleven means which are significantly lower at the .01 level of confidence.

In the high performing oral group there are six cell means significantly higher than the total group means for the SCAT scores, and three lower and ten higher at .01 level in the STEP scores.

The communication scores appear to show similar but less vivid relationships between performances in the low oral and high oral groups. As in the previous comparisons no group mean is significantly higher for the low oral group than the total group mean. Yet the high performing oral group does not show as much superiority over the total group as might be expected. This high performing oral group had in the Writing scores two means significantly lower, and two significantly higher; in the Listening scores one mean significantly lower and three significantly higher; in the Essay scores one mean significantly lower and one mean significantly higher; and in the Reading scores two significantly lower and three significantly higher. All comparisons were at the .01 level of confidence.

Comparison in Cells Having Equal Oral and Written Performance

As illustrated in Figure 1, cells Aa, Bb, Cc and Dd contain students of approximately equal oral and written performance. The number of correctly solved problems increases steadily from cell to cell, ranging from one or two correct solutions in Cell Aa to the highest performance in Cell Dd.

A comparison reveals that the cell means for I.Q., C.A., SCAT, and STEP scores show progressive increases from cell Aa to Dd in all cases save for chronological age, and for Writing scores at the first two levels. The SCAT scores are more noticeably increased than the STEP scores on Mathematics, Science, and Social Studies, and somewhat less than the communication scores of Writing and Essay. Specifically a comparison of the last three lines of the preceding table illustrates that cell Bb has higher mean performance than cell Aa on Mathematics, Science, Social Studies, Listening, and Essay with confidence at the .01 level. When compared to cell Bb, cell Cc makes mean marks which are higher with significance always at the .01 level. When compared with cell Cc, cell Dd has very slightly, but not significantly higher marks on the Otis Intelligence Test, and significantly higher marks with confidence at the .01 level on all academic tests with the sole exception of Essay.

It may thus be concluded that when groups are selected at four levels of the equal dominance continuum they reveal progressively rising scores for I.Q., for V, Q, and T, SCAT scores and for all STEP achievement scores save for Writing in the first two levels. These increases

Conditions in this Service which are relative performance

As illustrated in Figure 1, [illegible] is not an overall measure of organizational [illegible] and [illegible] performance. The [illegible] of currently [illegible] [illegible] [illegible]

are significant at the .01 level in twenty-seven out of the thirty-six comparisons shown in Table IX and confirm the association between intelligence (Otis), academic capacity (SCAT), and achievement (STEP) and rising scores on the continuum of even or equal oral and written Reasoning scores.

Comparisons of Cells Indicating Unequal Oral and Written Performance

The following comparisons deal with unequal oral and written performance. Cells Ca and Db represent performance in which the oral solutions are superior to written solutions. Cells Ac and Bd, on the other hand, represent better written performance (Table X).

When the combined means of the orally dominant group are compared to the combined means of the written dominant group they show that the oral group is slightly younger, slightly more intelligent and does less well on all the tests except Essay and Reading. While none of the differences is statistically significant, the group which has written dominance tends to be slightly superior except in Essay and Reading.

The total number of correctly solved problems is almost the same for cell Ca and cell Ac, temporarily called "low written" and "low oral" respectively. They differ only in the excess of orally solved problems over problems solved with written report, or the reverse. The "low written" group is slightly younger, less intelligent, and does less well on all tests except Essay, with the most noticeable difference being in the Qualitative score of the SCAT, Science, Writing, and Listening of the STEP series. The Writing difference is in accord with the classifi-

TABLE IX

MEANS FOR FOUR LEVELS OF EQUAL DOMINANCE REASONING SCORES AND CLOVER BAR INTELLIGENCE AND ACHIEVEMENT SCORES

	C.A.	I.Q.	SCAT			STEP						
Mean	Mo.	Otis	V	Q	T	M	Sc.	S.S.	W.	L.	E.	R.
Total	124.4	111.6	251.9	261.7	259.5	250.4	257.9	249.6	263.1	270.7	272.7	263.5
Cell Aa	131.3	94.1	241.5	253.5	251.6	238.7	246.9	236.9	251.8	257.7	261.4	247.4
Cell Bb	128.8	99.6	245.8	255.4	253.9	246.1	251.3	245.4	250.1	265.1	267.8	253.6
Cell Cc	121.0	117.8	251.2	260.2	258.3	253.3	259.7	253.2	264.9	272.0	276.3	267.0
Cell Dd	131.5	119.3	269.0	275.3	273.8	261.8	267.9	262.0	279.7	286.9	276.3	281.3
Bb - Aa	-2.5	5.5	4.3	1.9	2.3	7.4**	4.4**	8.5**	-1.7	7.4**	6.4**	6.2
Cc - Bb	-7.8**	8.2**	5.4**	4.8**	4.4**	7.2**	8.4**	7.8**	14.8**	6.9**	8.5**	13.4**
Dd - Cc	10.5**	1.5	17.8**	15.1**	15.5**	8.5**	8.2**	8.8**	14.8**	14.9**	0.0	14.3**

TABLE X

COMPARISONS OF CELLS INDICATING UNEQUAL ORAL AND WRITTEN PERFORMANCE

		C.A.	I.Q.	SCAT			STEP						
		Mo.	Otis	V	Q	T	M	Sc.	S.S.	W	L	E	R
	Total	124.4	111.6	251.9	261.7	259.5	250.4	259.9	249.6	263.1	270.7	272.7	263.5
Oral Dominance	Cell Ca	124.7	100.0	243.7	251.8	251.8	242.2	245.7	245.2	245.7	258.8	268.3	251.2
	Cell Db	121.3	114.1	253.4	257.0	257.3	249.6	258.5	245.9	261.9	273.3	271.1	265.5
	Ca, Db	122.9	107.5	248.9	254.6	254.7	246.1	252.5	245.6	254.3	266.5	269.7	258.8
Written Dominance	Cell Ac	128.0	106.0	249.3	262.0	257.7	245.3	255.5	248.5	259.0	270.0	268.3	257.5
	Cell Bd	124.7	101.3	250.0	262.0	259.0	251.6	256.2	249.2	252.0	268.0	257.0	253.9
	Ac, Bd	126.4	103.7	249.7	262.0	258.4	248.5	255.9	248.9	255.5	269.0	262.7	255.5
	Co-Cw N=26	-3.5	3.8	-.08	-7.4	-3.7	-2.4	-3.4	-3.3	-1.2	-2.5	7.0	3.3
	Ca-Ac N=12	-3.3	-6.0	-5.6	-10.2*	-5.9	-3.1	-9.8	-3.3	-13.3	-11.2*	0	-6.3
	Db-Bd N=14	-3.4	12.8**	3.4	-5.0	-1.7	-2.0	2.3	-3.3	9.9	5.3	14.1*	12.1*

cation of oral dominance. The "low written" means are lower, at the .05 level, on SCAT Qualitative and on Listening scores.

A comparison of the means of the Db and Bd cells, temporarily called "high oral" and "high written" respectively, reveals that here the "high written" group is older, but less intelligent (at the .01 level) and performs better on the test with the single exception of communication scores. The "high oral" group do noticeably better than the written group on Essay and Reading (at the .05 level).

If the cells Ca and Ac are classified as low problem solving cells, and cells Db and Bd as high problem solving cells, the final two lines of the above table may be summarized in two statements:

1. In the low problem solving group a comparison of the orally dominant with the written dominant pupils reveals that the oral pupils are younger, less intelligent, do less well on the tests of the SCAT-STEP series, with especially low performance on the Writing and Listening tests.

2. In the high problem solving group, the orally dominant pupils are younger, but much more intelligent, have relatively the same Verbal, Quantitative and Total SCAT scores; and Mathematics, Science, and Social Studies STEP scores, yet do much better than the written dominant group on the communication tests, particularly on Essay and Reading.

The above findings must be viewed with caution due to the fact that we are attempting to generalize concerning an extremely deviant group, and because of the relatively small number of individuals concerned.

It is thus apparent that where dominance mounts, either oral or

written, the I.Q. and achievement scores fall far below the upper levels of the equal dominance group. It may be noted also that the scores of the written dominant group are superior to those of the oral dominant group in I.Q. and achievement, save for Essay and Reading. While the above conclusions are tentative because of the low number of cases in each cell, they bear a relationship to later findings.

CHAPTER X

THE RELATIONSHIP BETWEEN THE REASONING TEST VARIABLES AND THOSE OF THE CLOVER BAR SURVEY DATA

In the preceding chapter the relationship between the achievement and intelligence variables of the Clover Bar Testing Program and those of the reasoning test were examined. In this chapter it is intended to explore the possible relationships between the variables of the Student Data Assembly Sheet and reasoning test performance. As in previous chapters, this comparison will be done in two stages. First there will be a comparison of data from cells of equidominance. Second the data from both the orally dominant and the written dominant cells will be scrutinized.

Social and Economic Correlates of Equidominance

The six major subdivisions of the Clover Bar Survey yielded data under the following headings: identification, family, education, economic, medical, and behavioral characteristics. These data were studied in the effort to identify characteristics which distinguished the equidominant group from the orally and written dominant groups.

Survey Data: Family

When data of each of the four cells of equidominance were compared, no clear difference was found with regard to birthplace of parent. Nor was the use of one or more languages in the home a distinguishing factor. While the number of brothers and sisters varied from cell to cell, they did not do so in any discernible pattern, being

3.4 for cell Dd, 1.9 for cell Cc, 3.8 for cell Bb, and 5.0 for cell Aa. This was true for length of residence in the community, employment of parents, and ownership of home, car, or T.V. Thus while performance in the equidominance group of cells ranged from very low to excellent, none of the items referring to family was positively related to success on the reasoning test.

Survey Data: Educational

Age at school entrance was very much the same for all four sections of the equidominance group, with few pupils entering before the age of six. While each cell group contained pupils who had repeated a grade, there was more likelihood that retardation would be found among those who had entered before six years than among those entering at six years or older. The number of retarded pupils was greatest in cell Aa, each of the other cells containing only one repeater. Whether a family had moved from one school section to another had usually not affected school progress, but repeated movements were sometimes associated with retardation.

Survey Data: Economic

The data regarding the occupations of the parents for each of the four equidominance cells were quite similar. However, income was below $3000 only for cases in the two lowest performing cells. The parent in cell Dd seemed slightly more likely to be a proprietor than the parent in cell Aa, but in general there was little difference in this respect from cell to cell.

[illegible] Jail [illegible] [illegible] Jail [illegible] [illegible] Jail [illegible]. This was true for inmates of [illegible] in the community, [illegible] or [illegible], and [illegible] of [illegible] [illegible]. [illegible] [illegible] [illegible]

Survey Data: Medical

The same uniformity reported in the preceding paragraph was found in the medical data. Premature births were rare, being found once in cell Aa and once in cell Dd. No cases of visual or hearing defects were present. All were negative to the Tuberculin Test. Two cases of enuresis were found in each cell group with the sole exception of Cc which had none.

Social and Economic Correlates of Oral and Written Performance

Next the two most marked orally dominant cells and the two cells of most marked written dominance were examined for patterns of similarity and dissimilarity. Here again no clear picture emerged. This might possibly be explained by the small number of cases in each cell. Information which appears pertinent is reported below.

Survey Data: Family

There was little discernible difference from cell to cell in the birthplaces of pupils or their parents. The two orally dominant cells contained a slightly larger number of homes in which a second language was spoken. Pupils in these same two groups reported more brothers and sisters than did those in the written dominant group. The orally dominant children appeared to differ from those who were dominant in written solutions in length of residence in the community. While the children of the orally dominant group frequently belonged to families which had recently moved to their present locality, only two families in the written dominant cells had changed location. Ownership of home and car was the same for both groups. All the families in the written

[illegible]: [illegible]

[illegible] [illegible] [illegible] [

group owned T.V. sets, but only about two-thirds of the families in the oral group.

Survey Data: Educational

All cells showed a similar age for school entrance and a similar amount of retardation. Several families in the oral group had moved from district to district, but only two families in the two written cells had lived in another district. The average number of school days lost was 7.2 for the oral group and 12.0 for the written group.

Survey Data: Economic

The economic data were almost identical for both groups with respect to occupation of father and reported family income. Apparently orally and written dominant pupils share common economic backgrounds.

Summary

The above data reveal the following relationships:

1. Repeated changes of family residence were frequently associated with retardation of the children.

2. Children of the orally dominant group frequently belonged to families which had recently moved to their present locality.

3. Low income of the parent was found only in the lowest performing cells of the equidominance group.

4. All the families in the written dominant group owned T.V. sets, as compared to about two-thirds of the families in the orally dominant group.

[illegible]

[illegible]

Survey Data: Educational

[illegible]

Survey Data: Economic

[illegible]

Summary

The above data reveal the following relationships:

1. Repeated changes of family residence were frequently associated with retardation of the children.

2. Children of the family [illegible] were frequently [illegible] to families which had recently moved to their present locality.

3. [illegible] of the parents was found only in the [illegible] [illegible] the [illegible] of the [illegible] group.

4. All the families in the written [illegible] [illegible], as compared to about two-thirds of the families in the [illegible] [illegible] group.

CHAPTER XI

CORRELATIONAL STUDIES OF THE RELATIONSHIP BETWEEN ORAL AND WRITTEN SCORES AND INTELLIGENCE AND ACHIEVEMENT VARIABLES

This chapter seeks to establish the relationship of a variety of academic measures to performance on the oral and written problems of the reasoning test. The test score data were obtained from the Clover Bar School Survey Testing Program conducted shortly after the administration of Burt's Reasoning Tests was completed. The tests administered to the students of grades four and five were: The School and College Achievement Test (Level 4); The Sequential Tests of Educational Progress: Reading, Writing, Listening, Mathematics, Science, Social Studies and Essay; and the Otis Quick-Scoring Tests of Mental Ability (Form Beta). This provided twelve variables to which chronological age was added making a total of thirteen.

The Reduced Sample, Means and Standard Deviations

Complete scores from the Clover Bar Testing Program were available for 265 of the 301 students in the original sample. Means and standard deviations for the thirteen variables are presented by sexes in Table XI.

Tests for significance of mean differences and for differences in variability between the complete sample of 301 and the reduced sample of 265 pupils failed to reveal any significant difference either in means or standard deviations. It was therefore concluded that the reduced group adequately represented the original sample.

Chapter II

Conditions Leading to the Development of Sound and the Science of Acoustics and Their Effect on Contemporary Technology

[illegible]

TABLE XI

MEANS AND STANDARD DEVIATIONS FOR MALES AND FEMALES IN REASONING, INTELLIGENCE AND ACHIEVEMENT VARIABLES

	Males		Females	
	Mean	Standard Deviation	Mean	Standard Deviation
N	128	128	137	
Age (mo.)	125.09	9.87	124.37	9.30
M.A.	133.72	14.95	138.45	16.33
I.Q.	107.34	13.09	111.59	14.65
SCAT V	249.56	11.06	251.87	10.08
SCAT Q	258.72	9.71	261.68	10.00
SCAT T	257.10	8.05	259.49	8.27
Mathematics	247.73	10.85	250.37	9.18
Science	254.84	11.34	257.94	8.79
Social Studies	248.10	11.91	249.56	9.17
Writing	253.86	14.17	263.06	14.19
Listening	268.80	11.06	270.70	10.55
Essay	266.23	13.20	272.70	11.25
Reading	256.64	15.28	263.48	13.43
(O-W) + 10	10.27	1.66	10.10	1.43
O	3.92	1.80	3.90	1.50
W	3.61	1.66	3.80	1.56
O+W	7.50	3.08	7.51	2.73

Zero Order Correlations Between Intelligence, Achievement, and Reasoning Variables

The intercorrelations of the thirteen variables for the combined male and female groups are recorded in Table XII.

Several observations may be made with respect to this table:

(a) The correlation between O and W over the whole group was .55, indicating that approximately 30% of the variance was common to the two variables. The absence of a high correlation between O and W offers support for experimental hypothesis H_2 (Chapter III) of the partial independence of the logical processes underlying O and W. The O and W correlations with Otis I.Q. were not high, .44 and .38 respectively. It is apparent that intelligence itself does not play a dominant role in the psychological processes involved in the reasoning scores.

(b) The average correlations[1] of the four reasoning scores with intelligence and achievement variables are as follows: (1) $r_o = .48$, (2) $r_w = .50$, (3) $r_{o+w} = .58$, (4) $r_{o-w} = .03$. It would appear that oral dominance (or written dominance) in itself is not highly related to the standard intelligence or achievement variables used in this study.

(c) The correlations of the O and W scores with the other tests yielded almost identical coefficients indicating that none of the standard tests employed here required one ability to a greater extent than the other.

(d) The low (non-significant) correlations of C.A. with the four reasoning variables indicated that C.A. was not an important factor in

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[1] In each case, correlations were averaged by converting to Fisher's Z.

[illegible]

[illegible]

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TABLE XII

INTERCORRELATIONS OF SCORES FOR INTELLIGENCE, ACHIEVEMENT AND REASONING
(N=265)

				SCAT							STEP						
	C.A.	M.A.	I.Q.	V	Q	T	Math.	Sci.	S.S.	W.	L.	E.	R.	O-W	O	W	O+W
C.A.	---	.08	-.47	.04	.30	.21	.18	.07	.09	.07	.10	.02	.08	-.06	.01	.07	.03
M.A.		---	.82	.70	.66	.77	.72	.72	.63	.71	.62	.48	.71	.03	.49	.49	.51
I.Q.			---	.59	.40	.54	.54	.58	.49	.56	.48	.42	.57	.09	.44	.38	.46
V				---	.59	.85	.64	.75	.69	.69	.67	.45	.76	.03	.51	.50	.54
Q					---	.91	.76	.64	.62	.65	.55	.38	.63	-.01	.45	.49	.57
T						---	.79	.75	.73	.74	.67	.44	.76	.00	.53	.56	.58
Math.							---	.75	.68	.69	.66	.38	.70	.05	.55	.55	.68
Science								---	.75	.75	.72	.47	.78	-.01	.50	.55	.56
Soc.Studies									---	.66	.67	.37	.71	.00	.53	.56	.56
Writing										---	.63	.48	.79	-.03	.45	.50	.44
Listening											---	.41	.67	.06	.54	.62	.74
Essay												---	.44	.01	.26	.27	.23
Reading													---	-.03	.48	.54	.54
O-W														---	.49	-.43	.05
O															---	.55	.86
W																---	.84
O+W																	---

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

the determination of these scores within the restricted age range of this sample.

The intercorrelations were next computed individually by sexes, in the hope of uncovering sex differences. The results are presented in Tables XIII and XIV.

The most prominent relationship found in these tables may be listed as follows:

(a) Ten of the twelve O correlations were higher for the males than for the females. Although differences in individual coefficients were not significant, the null hypothesis that the two samples were drawn from populations in which O covaried to the same extent with achievement and intelligence variables was rejected at the .05 level of confidence. At the same time, the O correlations with achievement variables tended to be higher for males than the corresponding W correlations. It would appear that the factor or ability underlying the other test scores, perhaps a logical-spatial factor, enters into the O scores to a greater extent for males than for females. The higher male correlations are particularly noticeable for the subjects in which males usually excel, viz., mathematics and science.

(b) A majority of the W correlations tended to be higher for females than for males although the trend was not well enough defined to be statistically significant. Moreover, the W correlations with achievement variables tended to be higher in the case of females than the corresponding O correlations for females. It would seem plausible to argue that the factor underlying W played a more prominent role in

[illegible]

[illegible]

[illegible]

[illegible]

(a) [illegible]

(b) [illegible]

(c) [illegible]

(d) [illegible]

TABLE XIII

TEST INTERCORRELATIONS FOR INTELLIGENCE, ACHIEVEMENT AND REASONING
(Females, N = 137)

				SCAT						STEP						
	C.A.	M.A.	I.Q.	V	Q	T	Math.	Sci.	S.S.	W.	L.	E.	R.	O-W	O	W
C.A.	---	.04	-.47	.04	.28	.22	.17	.08	.12	.14	.10	-.01	.08	-.07	-.01	.06
M.A.		---	.84	.68	.66	.75	.73	.75	.62	.73	.67	.44	.64	-.07	.49	.53
I.Q.			---	.58	.42	.54	.54	.60	.47	.54	.52	.40	.50	.03	.47	.42
V				---	.56	.82	.60	.77	.67	.69	.69	.33	.31	-.06	.44	.48
Q					---	.92	.76	.65	.64	.67	.50	.31	.58	-.06	.44	.48
T						---	.78	.77	.75	.75	.66	.34	.71	-.06	.51	.55
Math.							---	.73	.67	.71	.62	.36	.62	-.09	.48	.54
Science								---	.74	.73	.72	.41	.76	-.21	.41	.59
Soc.Studies									---	.66	.66	.29	.67	-.06	.46	.50
Writing										---	.63	.39	.77	-.16	.40	.53
Listening											---	.37	.64	-.13	.49	.59
Essay												---	.32	-.09	.25	.32
Reading													---	-.13	.39	.50
O-W														---	.43	-.50
O															---	.56
W																---

Since comparisons to reveal possible sex differences are being sought, there is value in deferring discussion of the female group correlations until corresponding male group correlations are listed, in Table XIV on the succeeding page.

TABLE XIV

TEST INTERCORRELATIONS FOR INTELLIGENCE, ACHIEVEMENT AND REASONING
(Males, N = 128)

				SCAT						STEP						
	C.A.	M.A.	I.Q.	V	Q	T	Math.	Sci.	S.S.	W.	L.	E.	R.	O-W	O	W
C.A.	---	.14	-.47	.05	.34	.21	.19	.06	.07	.09	.11	.06	.10	-.05	.02	.08
M.A.		---	.80	.72	.64	.77	.72	.69	.66	.67	.56	.50	.77	.16	.51	.44
I.Q.			---	.59	.34	.53	.52	.57	.52	.55	.41	.40	.62	.17	.43	.32
V				---	.62	.88	.67	.73	.71	.71	.64	.54	.80	.13	.57	.52
Q					---	.90	.76	.62	.62	.61	.58	.40	.65	.05	.48	.49
T						---	.79	.74	.73	.73	.67	.51	.81	.08	.57	.57
Math.							---	.76	.68	.67	.69	.36	.75	.17	.62	.55
Science								---	.75	.77	.72	.48	.79	.15	.58	.52
Soc.Studies									---	.69	.69	.41	.75	.04	.58	.60
Writing										---	.64	.48	.79	.13	.55	.48
Listening											---	.42	.70	.02	.59	.65
Essay												---	.48	.13	.29	.22
Reading													---	.07	.58	.58
O-W														---	.54	-.36
O															---	.55
W																---

TABLE [illegible]

[illegible]
(VOL = [illegible])

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

determining the female test score than the ability involved in the O score.

(c) Related to (a) and (b), a statistically significant trend was found toward positive O-W correlations with achievement variables for males and negative correlations with the same variables for females. One outstanding instance is found in the Science scores which correlated with O-W to the extent of -.21 for the females and .15 for the males, a difference which was significant at the .05 level.

Partial Correlation Studies

The partial correlation studies were undertaken in the hope that further patterns of sex differences would emerge. The analyses encompassed two stages. In the first stage each of the reasoning variables O-W, O, and W was correlated with each of the other achievement and intelligence variables, while the latter were held constant one at a time. In the second stage, the partial correlations were calculated separately for each sex and for each of the variables O-W and O with the intelligence and achievement variables again held constant one at a time. The tables of partial correlations have been placed in Appendix D.

Consistent patterns of the following type emerged: the decrease in the correlation coefficients (reasoning scores with achievement variables) between the zero order and the first order partial coefficients with O held constant was larger for males than for females.

This is illustrated in Table XV where the zero order and first

order partial correlations between O-W and V are shown. However, since this and similar results can be traced back to the initial sex difference in the zero order coefficients, the results did not seem to reveal new information, and are not discussed further.

TABLE XV

SEX DIFFERENTIAL IN THE DECREASE BETWEEN ZERO ORDER CORRELATES AND FIRST ORDER PARTIALS WITH O HELD CONSTANT

	Zero Order O-W and V	First Order Partial O-W and V With O Held Constant	Change
Male	.13	-.25	-.38
Female	-.06	-.31	-.25

Multiple Correlation Studies

Two motives prompted a further calculation of multiple correlation coefficients. On the one hand it was felt that patterns of sex differences might be observed in the predictor variables. Again there was a desire to determine the extent to which the reasoning variables, O, W, and O-W, could be predicted from the battery of intelligence and achievement tests employed in this study.

The Horst (1954) iteration method was used to calculate the relative beta weights and the multiple coefficients of correlation. These are presented in Table XVI.

[illegible] partial correlations between C-[illegible] and [illegible]. However, [illegible] obtained [illegible] may be [illegible] in the [illegible] in the zero order coefficients, [illegible] information, and are not discussed further.

TABLE [illegible]

[illegible] OF DIFFERENCES IN [illegible] ZERO ORDER [illegible]

[illegible] WITH C [illegible]

	Zero Order C-[illegible] and [illegible]	First Order Partial C-[illegible] and [illegible] With C Held Constant	[illegible]
[illegible]	[illegible]	-.[illegible]	-.[illegible]
[illegible]	-.[illegible]	-.[illegible]	-.[illegible]

Multiple Correlation Studies

[illegible] provided a further [illegible] of multiple correlation coefficients. On the one hand it was felt that [illegible] of sex differences might be observed in the predictor variables. [illegible] desire to determine the extent to which the [illegible] variables, [illegible], [illegible] and C-[illegible], could be predicted from the battery of intelligence and achievement tests employed in this study.

The [illegible] (1962) iteration method was used to calculate the relative beta weights and the multiple coefficients of correlation. These are presented in Table XVI.

TABLE XVI

RELATIVE CONTRIBUTIONS TO BETA COEFFICIENTS

Group	Var	Rc	CA	MA	IQ	V	Q	T	Math	Sci	SS	W	L	E	R
Total	Oral Dom.	.091			.14				.04	-.03		-.06	.07		-.08
Females	Oral Dom.	.258			.16	.35		.10		-.53	.09	-.33	-.16		.32
Males	Oral Dom.	.157			.17		.06		.23		-.07	.06	-.17	.08	
Total	Oral Scores	.607		-.05	.11	.10			.30		.10		.19		
Females	Oral	.540	-.14		.09			.45		-.14	.07		.15		
Males	Oral	.653	-.08			.08			.40		.12		.16		
Total	Written	.647					.15		.07		.10		.42	-.05	.06
Females	Written	.673	.05			-.04	.18			.11		.07	.42		
Males	Written	.673						.15		.05	.19		.50	-.11	.05

TABLE [illegible]

CORRELATIONS [illegible] BY [illegible] STRATA

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]		[illegible]	[illegible]				[illegible]			[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]			[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]			[illegible]	[illegible]	[illegible]
		[illegible]		[illegible]		[illegible]			[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
		[illegible]		[illegible]	[illegible]		[illegible]			[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]		[illegible]		[illegible]			[illegible]			[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]					[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]		[illegible]			[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]						[illegible]	[illegible]	[illegible]

Dealing first with the extent to which prediction of the reasoning variables was possible, the written scores for the whole sample showed the highest predictability with 42% of their variance being attributable to the thirteen predictors of the battery. At the same time these predictors explained 37% of the variance of the oral scores and less than 1% of the variance of the oral dominance scores.

Certain sex differences were observed in the relative size of the predictors. This was particularly clear in the case of the O-W variables where high beta coefficients were contributed by Science (-.35), V (.35), and W (-.33) scores for females while the corresponding beta coefficients for the males were small to the point of insignificance. For the oral scores the principal sex difference lay in the fact that the largest predictor for the females was the SCAT Total score, while Mathematics was the best predictor for the males. There is a suggestion here, that, in addition to the quantitative differences between scores with respect to the ability underlying the oral scores, there may be qualitative differences between the sexes in this ability as well.

Summary

This chapter presented the results of the studies of zero order, first order partial, and multiple correlations between the reasoning scores and the achievement and intelligence variables of the Clover Bar Survey. A reduced sample was employed consisting of the 265 students for whom complete data was available. Tests of significance revealed that this sample adequately represented the original sample of 301 subjects.

The most important results may be summarized as follows:

(a) The correlation between O and W over the whole group of 265 pupils was .55, which is in agreement with the hypothesis that oral and written performance are to some extent psychologically distinct. This position was further supported by the markedly different pattern of predictors for oral and written scores which emerged from the multiple correlation studies. The low correlations of O and W with Otis I.Q. (.44 and .38 respectively) indicated that intelligence did not play a dominant role in the psychological processes underlying these scores.

(b) The correlations between oral scores and the intelligence and achievement variables were higher for males than for females in such a large proportion of cases as to dispel any doubt that this effect could have occurred by chance. Since, in addition, the O correlations with achievement variables tended to be higher for males than the corresponding W correlations, it would seem a reasonable deduction that the factor or ability underlying the achievement and intelligence scores enters into the O score to a greater extent for males than for females.

(c) Although not quite so well defined the picture for females was completely reversed. A majority of the W correlations with achievement variables tended to be higher than the corresponding female O score correlations.

(d) A further result which was apparently related to (b) and (c) appeared in the tendency toward positive O-W correlations with achievement variables for males, and negative correlations with the same variables for females.

(e) Holding O constant consistently led to a greater increase in the differences between zero order and first order partial correlations for males than for females. Similarly holding W constant led to consistent and increasing differences between zero order and first order partial correlations for females than males.

(f) The thirteen predictors of the Clover Bar Survey yielded multiple coefficients of correlation of .607, .647, and .091 for the variables O, W, and O-W respectively. In addition, there were marked sex differences in the relative importance of the different predictors.

CHAPTER XII

A FURTHER STUDY OF SEX DIFFERENCES

The correlation studies of the last chapter employed the reduced sample (N=265) for which complete Clover Bar data were available. In order to make comparisons between the sexes, means and standard deviations were computed for each of the thirteen experimental variables. Each difference was tested for significance and the results are shown in Table XVII.

It is evident from Table XVII that the females scored higher in all the achievement variables. However, since the females enjoyed a highly significant superiority of more than four points in I.Q., their superior scores in variables which themselves correlate moderately with intelligence is not at all surprising.

The one noticeable difference in favor of the males was found in the O scores. While this difference was not statistically significant, it seemed reasonable to believe that since the males scored higher than the females, despite their lower intelligence, the males might conceivably be significantly superior in O to females of equal intelligence.

Again, it seemed likely that the females' slight advantage in W might be solely attributable to their superior intelligence in the sample used in this investigation.

The Matched Groups

While the sex difference in intelligence posed no serious obstacles

TABLE XVII

COMPARISON OF REASONING, INTELLIGENCE AND ACHIEVEMENT SCORES OF MALES AND FEMALES

	Means				Standard Deviations			
	Males	Females	Diff. M-F	Conf.* Level	Males	Females	Diff. M-F.	Conf. Level
N	128	137			128			
Age (mo.)	125.09	124.37	.72	---	9.87	9.30	.57	---
M.A.	133.72	138.45	-4.73	.02	14.95	16.33	-1.38	---
I.Q.	107.34	111.59	-4.25	.02	13.09	14.65	-1.56	---
SCAT V	249.56	251.87	-2.31	---	11.06	10.08	.98	---
SCAT Q	258.72	261.68	-2.96	.02	9.71	10.00	- .29	---
SCAT T	257.10	259.49	-2.39	.02	8.05	8.27	- .22	---
Math.	247.73	250.37	-2.64	.05	10.85	9.18	1.67	---
Science	254.84	257.94	-3.09	.02	11.34	8.79	2.55	.01
Social Studies	248.10	249.56	-1.46	---	11.91	9.17	2.74	.01
Writing	253.86	263.06	-9.20	.01	14.17	14.19	- .02	---
Listening	268.80	270.70	-1.90	---	11.06	10.55	.51	---
Essay	266.23	272.70	-6.47	.01	13.20	11.25	1.95	---
Reading	256.64	263.48	-6.84	.01	15.28	13.43	1.85	---
(O-W) + 10	10.27	10.10	.17	---	1.66	1.43	.23	---
O	3.92	3.90	.02	---	1.80	1.50	.30	.05
W	3.61	3.80	- .19	---	1.66	1.56	.10	---
O+W	7.50	7.51	- .01	---	3.08	2.73	.35	---

*Confidence Level is abbreviated to Conf. Level.

to the correlational studies, the question of sex differences in the reasoning variables could only be fairly assessed by comparing groups of equal intelligence.

For this purpose, male and female students were matched on Otis I.Q. and as closely as possible on M.A. Since I.Q. was first held constant, matching on M.A. was equivalent to matching on C.A. It was possible to match 50 pairs of students at the grade four level and 41 pairs at the grade five level, yielding a total population of 182 subjects.

The adequacy of the matching for intelligence, M.A. and C.A. is illustrated in Table XVIII where means are provided for both grade levels.

TABLE XVIII

MEAN OTIS I.Q. AND MEAN M.A. FOR THE MATCHED GROUPS GRADES FOUR AND FIVE

		Mean Otis I.Q.	Mean M.A.
Grade Four	Male	111.90	132.18
	Female	111.92	132.46
Grade Five	Male	109.34	142.68
	Female	109.30	142.78

It is evident that the matching was entirely satisfactory with

respect to I.Q. and M.A., and therefore with respect to C.A. as well.

The means and standard deviations for the reasoning variables are presented in Tables XIX and XX.

The significance of the male-female differences between correlated means of scores in the four reasoning variables was tested by the 'difference method' (Garrett, 1953). The significance of the differences between uncorrelated means (male-male and female-female comparisons) was tested by the t-test. The Cochran and Cox test was employed in cases bordering upon significance. Because of the previously mentioned uncertainty as to whether the O-W or the O+W scale can be regarded as true interval scales, the significance of the differences for these variables was tested in addition by the sign test (Siegel, 1956). The results may be listed as follows:

(a) The grade four males were appreciably superior to the grade four females in O, and O+W, and slightly inferior in W, although none of the results was significant at the .05 level.

(b) The grade four males scored significantly higher at the .05 level in O-W than the grade four females.

(c) The grade five males were significantly superior at the .01 level of confidence in O and O+W to the grade five females and scored higher in W and O-W, although the two latter results were not significant at the .05 level.

(d) When grades four and five were combined, the males scored significantly higher than the females in O, O+W and O-W ($P < .05$), and were slightly superior in W.

[illegible]

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TABLE XIX

MEANS SCORES IN THE REASONING VARIABLES FOR MALES AND FEMALES OF THE MATCHED GROUP (GRADES FOUR AND FIVE)

		O	W	O+W	O-W
Grade Four (N=100)	Males	3.88	3.36	7.24	.52
	Females	3.50	3.52	7.02	-.02
Grade Five (N=82)	Males	4.61	4.46	9.07	.15
	Females	3.93	4.15	8.08	-.22
Total (N=182)	Males	4.21	3.86	8.07	.35
	Females	3.68	3.80	7.48	-.12

TABLE XX

STANDARD DEVIATIONS OF THE REASONING VARIABLES FOR MALES AND FEMALES OF THE MATCHED GROUPS (GRADES FOUR AND FIVE)

		O	W	O+W	O-W
Grade Four (N=100)	Males	2.18	1.51	3.24	1.65
	Females	1.29	1.20	2.12	1.60
Grade Five (N=82)	Males	1.70	1.60	2.94	1.53
	Females	1.67	1.48	2.92	.65
Total (N=182)	Males	1.80	1.65	3.22	1.20
	Females	1.46	1.36	2.56	2.12

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[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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(e) The combined grades four and five male scores in O, W, O-W, and O+W were significantly more variable at the .01 level of confidence than the corresponding female scores. The largest differences in variability were observed at the grade four level where the males were significantly superior in O and O+W at the .01 level of confidence, and in W at the .05 level of confidence. At the grade five level the female O-W scores were significantly more variable than the corresponding male scores.

(f) For both males and females, the grade five scores in O, W, and O+W were significantly higher than the corresponding grade four scores at the .01 level of confidence.

The evidence for sex differences is unequivocal. The suspected male superiority in O and O+W was realized and it appears that the small female superiority in W which was observed in the larger sample (N=301) disappeared when intelligence was controlled.

The Maturation Sequence in Verbal Reasoning

In this section we return to the two central hypotheses of the thesis:

> H_3: With advance in age and grade the reasoning activity involved in problem solving changes from a state of oral dominance in the direction of equidominance.
>
> H_4: Since females are assumed to be more advanced in maturation, girls will tend to exhibit a progress away from oral dominance in the direction of equidominance.

A maturational movement beyond the equidominance point in the direction of written dominance is entirely consistent with the above

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hypotheses, which might in fact be revised as follows:

> H_3: With advance in age and grade, the reasoning activity involved in problem solving changes from a state of oral dominance through a state of equidominance to a state of written dominance.
>
> H_4: Since females are assumed to be more advanced in maturation, girls will tend to exhibit a greater progress away from oral dominance in the direction of equidominance and written dominance.

The findings of the chapter are in excellent harmony with both hypotheses. The complete results are somewhat difficult to grasp by mere inspection of the numerical data and for that reason are presented graphically in Figure 2.

The eight mean values for the O and W variables at grade levels four and five were plotted on the vertical lines. When corresponding grade scores were joined (e.g. grade four O male and grade five O male) and the joining lines extrapolated,[1] the straight lines shown in the diagram resulted.

The diagram reveals clearly the postulated maturational movement away from oral dominance in the direction of written dominance. It also reveals the postulated female superiority in progress in the movement toward equidominance; in fact, for the sample under consideration

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[1]The extrapolation downward beyond grade four is equivalent to the assumption that the students' progress in the oral and written techniques of problem solving is a linear function of time. This hypothesis would require further checking by taking additional cross sectional samples (at grade three for example), and is not crucial to the argument here. The linearity assumption is merely the simplest one which can be made, and the discussion which follows is not invalidated if the lines in question were subsequently proven to be curvilinear.

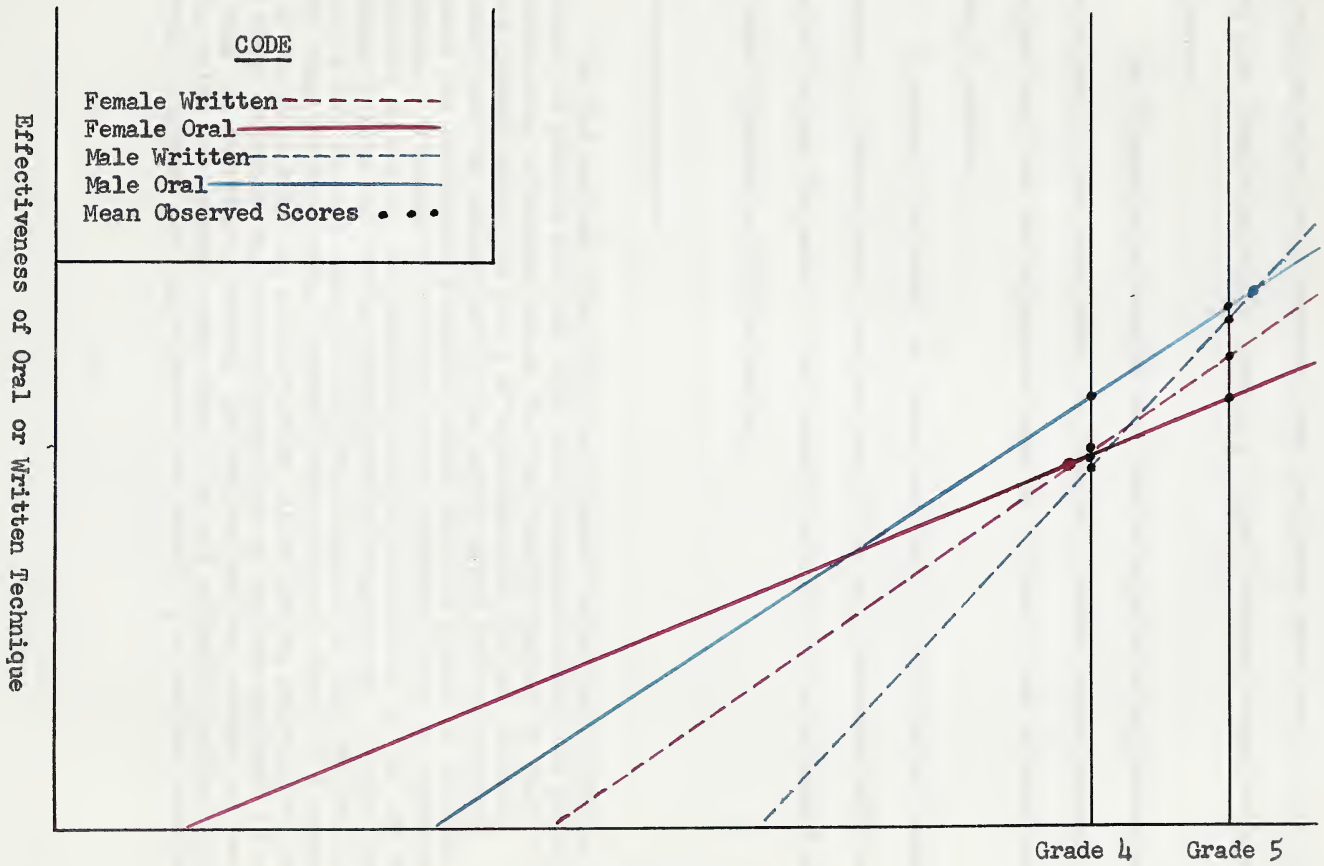

FIGURE II

DIAGRAMMATIC REPRESENTATION OF MATURATIONAL PROGRESS TOWARDS WRITTEN DOMINANCE

the equidominance point occurred near the grade four level[1] with the grade five females actually showing a slight tendency toward written dominance.

The diagram also reveals that the male point of equidominance is at a much higher level than the females, a result which follows from the fact that the males are superior in the O, and to some extent in the W, scores.

In summary the study of groups matched in intelligence presents a picture of maturational progress away from oral dominance with the females leading the males. Both results were in entire agreement with the basic hypothesis of this thesis.

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[1]In the earlier study with the reduced sample the direction of movement for females was away from oral dominance toward the point of equidominance, a position which they had nearly reached by grade five. In the present study the point of equidominance for the females occurred near the grade four level, and by grade five the female students had progressed slightly beyond into the region of written dominance. Although both results are in agreement with the experimental hypotheses H_3 and H_4, the apparent lack of coincidence of the two equidominance points for females needs further explanation. In the first place the two studies employed different samples so that one would not expect complete agreement. However, the principal cause of discrepancy lay in the fact that the earlier study classified as non-equidominant only those students who were markedly oral or written dominant (i.e. for whom the difference between the oral and written scores was two or more), while the present study classified all students for whom $O > W$ as orally dominant and all students for whom $O < W$ as written dominant.

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CHAPTER XIII

FINDINGS AND IMPLICATIONS

This study was designed to discover whether variations in oral and written performance were associated with factors such as age, sex, intelligence, and academic achievement, as well as biological and sociological variables.

Rationale, Definitions and Hypotheses

When written and oral performance are viewed from the point of view of the 'operational thought' concepts of Piaget, it appears that the net advantage must lie with the mature use of the written technique. This is true because the written technique, in permitting the drawing of diagrams and the elaboration of intermediate steps of an argument, effects a partial sensory recreation of the system reasoned about, and therefore to some extent dispenses with the necessity of a purely imaginative recreation and retention of the system. Thus at the upper end of the maturational scale, we would expect to find that written performance would allow problem solving at a higher difficulty level than would oral performance, while at the lower end, where oral experience precedes written experience by several years, the oral technique would be expected to dominate. Hence, we are led to postulate a point of equidominance and a maturational movement away from the oral dominance of the early years to the written dominance of the adult years. The picture is further complicated by a commonly accepted hypothesis of a maturational advantage

possessed by females.

The theoretical considerations gave rise to several experimental hypotheses which directed the course of the experimental investigations.

H_1: There exist sex differences in the O, W and O+W scores.

H_2: Oral performance (O) is to some extent different from written performance (W).

H_3: With advance in age and grade the reasoning activity involved in problem solving changes from a state of oral dominance in the direction of equidominance.

H_4: Since females are assumed to be more advanced in maturation, girls will tend to exhibit a greater progress away from oral dominance in the direction of equidominance.

H_5: The oral reports given by girls for correct solutions tend to be rated more highly than the oral reports for corresponding correct solutions given by boys.

H_6: Written as opposed to oral dominance is positively related to intelligence and achievement.

The O and W scores refer to the number of problems correctly answered in Burt's Reasoning Test by the oral and written techniques respectively. A student who performed equally well in O and W was said to be equidominant. If the O score exceeded the W score, the student was said to show oral dominance, while if the W score exceeded the O score, he was said to be written dominant. The rating score was not determined by the correctness or incorrectness of the answer to the problem, but represented the interviewer's assessment of the adequacy

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of the oral or written report in explaining the solution obtained.

Tests, Administration, and Statistical Techniques

In addition to Burt's Reasoning Test, the study employed all the tests and student information sheets of the Clover Bar Survey, including the Otis Quick-Scoring Test of Mental Ability, the School and College Aptitude Test, and the Sequential Tests of Educational Progress. The student information sheet yielded data which were largely of a social and economic nature. The sample consisted of 301 students of grades four and five.

The individual testing sessions were conducted by a team of five interviewers, and statistical checks indicated that the measures introduced to ensure uniformity of marking resulted in a self-consistency on the part of each interviewer and a consistency between the interviewers which was adequate for the purposes of the experiment.

Among the statistical techniques employed were parametric tests of significance (t-tests and F-tests), non-parametric tests of significance (sign test, median test, Kolmagorov-Smernov test), parametric measures of relationship (zero order, first-order partial, and multiple coefficients of correlation) and non-parametric measures of relationships (ϕ coefficient and χ^2). Since the adequacy of the O-W scale was somewhat in question all results yielded for this variable by parametric tests were checked by non-parametric tests as well.

of the need to develop models to determine the optimal operating conditions.

Data, Instrumentation, and Experimental Procedure

In addition to [illegible] the [illegible] models, the [illegible] data were used extensively throughout the course of this study. Although the data [illegible] were [illegible] [illegible] [illegible]

Results

The major findings became more intelligible when listed under their appropriate experimental hypotheses. These are dealt with in turn.

(A) H_1: There exist sex differences in the O, W and O+W scores.

The experimental findings are quite conclusive in this area. A preliminary comparison of means for the entire sample (N=301) showed a slight superiority (non-significant) in favour of the males in the O scores despite the fact that the females possessed on the average a four point advantage in Otis I.Q.

Next ninety-one male-female pairs were matched on Otis I.Q. which resulted in equal group means for M.A. and C.A. The results of tests of significance can be summarized as follows:

(a) The grade four males were appreciably superior to the grade four females in O, and O+W, and slightly inferior in W, although none of the results was significant at the .05 level.

(b) The grade four males scored significantly higher at the .05 level in O-W than the grade four females.

(c) The grade five males were significantly superior at the .01 level of confidence in O and O+W to the grade five females and scored higher in W and O-W, although the two latter results were not significant at the .05 level.

(d) When grades four and five were combined, the males scored significantly higher than the females in O, O+W and O-W ($P < .05$), and were slightly superior in W.

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(e) The combined grades four and five male scores in O, W, O-W, and O+W were significantly more variable at the .01 level of confidence than the corresponding female scores. The largest differences in variability were observed at the grade four level where the males were significantly superior in O and O-W at the .01 level of confidence, and in W at the .05 level of confidence. At the grade five level the female O-W scores were significantly more variable than the corresponding male scores.

Further evidence of sex differences in the reasoning variables was found in the correlational studies. The correlations between oral scores and the intelligence and achievement variables were higher for males than for females in such a large proportion of cases as to dispel any doubt that this effect could have occurred by chance. Since, in addition, the O correlations with achievement variables tended to be higher for males than the corresponding W correlations, it would seem a reasonable deduction that the factor or ability underlying the other test scores enters into the O score to a greater extent for males than for females. Although not quite so well defined, the picture for females was completely reversed. A majority of the W correlations with achievement variables tended to be higher than the corresponding female O score correlations.

Sex differences were also found in the partial correlation studies, but it appeared that these differences could be traced back to the original difference in the zero order coefficients.

The findings reviewed to this point deal largely with quantitative sex differences in O and W. Some suggestion of qualitative differences

in the abilities underlying the O and W scores was found in the distinct pattern of beta weights which emerged from the multiple correlation studies.

(B) H_2: Oral performance (O) is to some extent different from written performance (W).

The O and W scores for the combined grades correlated to the extent of .55 indicating that the relationship between the variables was not high. This fact, coupled with the markedly distinct pattern of predictors, suggests that the psychological processes underlying the two scores may be somewhat different, aside from the quantitative differences already discussed.

The exact nature of these psychological processes was not revealed by this study. It turned out that the average correlations of O and W with the achievement variables centred about .5, while their correlations with Otis I.Q. were in the neighbourhood of .4. It is, therefore, apparent that intelligence itself does not play a dominant role in the psychological processes involved in the reasoning scores.

(C) H_3: With advance in age and grade the reasoning activity involved in problem solving changes from a state of oral dominance in the direction of equidominance.

H_4: Since females are assumed to be more advanced in maturation, girls will tend to exhibit a greater progress away from oral dominance in the direction of equidominance.

These hypotheses are discussed together since the results of three experimental studies bear upon both. In a preliminary study employing the entire sample (N=301), the tendency towards equidominance was observed. It was also apparent that the females had approached more closely to equi-

dominance than the males at both the grade four and grade five levels.

Since none of the results of the preliminary analysis was statistically significant, a further analysis employed the members of the reduced group (N=265) who were markedly oral or written dominant to the extent that they showed a difference of two or more points between the oral and written scores. When the sample was dichotomized at each grade level into equidominance and non-equidominance groups, the trend toward equidominance between grade four and grade five was significant at the .05 level.

The third attack on the problem came in the study of matched groups (N=162). When the mean scores at each grade level were plotted and the trend lines drawn, a graphical picture emerged which showed remarkable agreement with the basic hypotheses of the thesis. The females in this group had actually passed the point of equidominance and had entered the region of written dominance, while the males had made significant progress toward the equidominance point between grades four and five.

(D) H_5: The oral reports given by girls for correct solutions tend to be rated higher than the oral reports for corresponding correct solutions given by boys.

While this hypothesis was substantiated at the .05 level over a series of problems which included (1) an easy problem, (2) a problem of moderate difficulty, (3) two difficult problems, closer examination revealed a somewhat more subtle relationship.

The female interviewer ratings for correct answers to the easy problems was significantly higher ($P < .01$) than the corresponding male ratings, but as the problem difficulty rose, the assessment of the

reports of solutions for problems correctly answered shifted in favour of the males. The overall ratings for written solutions showed no significant sex difference, although male ratings for the difficult problems were again markedly higher than the females.

If we interpret the O and W scores as the subject's logical output, and the interviewer ratings as the subject's effectiveness in presenting his arguments, then it would appear that the female, through her superior facility in the use of language, is able to present her arguments more convincingly than a male who possesses the same logical grasp of the problem.

When the result is considered in the light of the observed male superiority in O, there emerges the possibility that the female may be attempting to balance her relative weakness in oral reasoning (O) by relying to a greater extent on her verbal facility.

A further result not directly related to H_5 was obtained when median assessments of problems correctly answered were computed for both grade levels. Here, a maturational movement was found which parallelled that previously observed for the O and W scores. For not only were the grade five assessments for oral and written solutions significantly higher than the corresponding grade four assessments, but a movement toward equality of oral and written assessments was found.

(E) H_6: Written as opposed to oral dominance is positively related to intelligence and achievement.

This hypothesis was not supported by the data; indeed, it was oral rather than written dominance which correlated positively with the

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intelligence and achievement variables, although the coefficients were extremely small, averaging .03. In addition, the entire battery of thirteen predictors in the multiple correlation study explained less than one per cent of the variance in the O-W scores. The only other evidence bearing on this hypothesis was found in the study of equidominant, oral dominant, and written dominant cells, where it appeared that the optimum distribution of total logical output (O+W) occurred when the O and W scores were equal. The further indication that extreme written dominance is a somewhat superior condition to extreme oral dominance was very tenuous since it was based on a small number of cases.

The study of correlates of oral and written dominance was probably doomed to failure because it happened that the experiment was conducted with an age group in which many students were close to the equidominance point, with the result that the dominance scores were necessarily small. Moreover, since every student presumably passes through stages of oral dominance, equidominance, and written dominance, no consistent or permanent relationship could be expected between written dominance and a variable such as intelligence within the transition period. It is possible, however, that such a study might yield valuable insights at a later stage in the maturational process, when sizable and permanent differences in dominance could be observed.

Implications for Further Research

This thesis has attempted to explore an area which has been virtually ignored by workers in the field of psychological research.

The present study raises more questions than it answers. Two problems seem to possess particular promise.

(a) The Maturational Continuum. This thesis investigates only two points on the maturational continuum which seems to pass from oral dominance through equidominance into written dominance. Similar studies of the reasoning performance of students in the junior and senior high schools would yield a more complete picture of the maturational pattern. Classroom practice would undoubtedly be affected by the findings.

(b) Sex Differences. Evidence of systematic sex differences in oral and written reasoning revealed by this study warrant further examination. The projected pattern of sex differences before grades four and five and afterwards is hypothetical and demands confirmation or denial. Further exploration of this area would add appreciably to our increasing insight into this problem.

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APPENDIX A

BURT'S GRADED REASONING TESTS

1. Tom runs faster than Jim: Jack runs slower than Jim. Who is the slowest--Jim, Jack or Tom?

2. Kate is cleverer than May: May is cleverer than Jane. Who is the cleverest--Jane, Kate or May?

3. I have bought the following Christmas presents: a pipe, a blouse, some music, a box of cigarettes, a bracelet, a toy engine, a bat, a book, a doll, a walking-stick and an umbrella. My brother is eighteen; he does not smoke, nor play ball, nor play the piano. I want to give the walking-stick to my father and the umbrella to my mother. Which of the above shall I give to my brother?

x x x x x x x x x x x x x x x

4. I don't like sea voyages: and I don't like the seaside. I must spend Easter either in Hawaii, or Jasper, or on the West coast. Which shall it be?

5. The person who stole Brown's purse was neither dark, nor tall, nor clean-shaven. The only persons in the room at the time were: (1) Jones, who is short, dark and clean-shaven. (2) Smith, who is fair, short and bearded. (3) Grant, who is dark, tall, but not clean-shaven. Who stole Brown's purse?

x x x x x x x x x x x x x x x

6. Three boys are sitting in a row: Harry is to the left of Willie; George is to the left of Harry. Which boy is in the middle?

7. In cold, damp climates, root crops like potatoes and turnips grow best: in temperate climates there are abundant pastures, and oats and barley flourish; in sub-tropical climates, wheat, olives and vines flourish. The ancient Greeks lived largely on bread, with oil instead of butter: they had wine to drink and raisins for fruit. Which climate do you think they had?

x x x x x x x x x x x x x x x

8. The doctor thinks Violet has caught some illness. If she has a rash, it is probably chicken-pox, measles or scarlet fever. If she has been ailing with a cold or cough she may develop whooping-cough, measles or mumps. She has been sneezing and coughing for some days, and now spots are appearing on her face and arms. What do you think is the matter with Violet?

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9. There are four roads here. I have come from the South and want to go to Melton. The road to the right leads somewhere else: straight ahead it leads only to a farm. In which direction is Melton--North, South, East, or West?

x x x x x x x x x x x x x x x x

10. Father has just come home in a brand new overcoat: there is mud on his boots, and flour on his hat. The only places he can have been to are Northgate, Southgate, Westgate or the City. He has not had time to go to more than one of these. There is no mud anywhere in the streets except where the pavement is up for repair. There are tailor shops only in Southgate, Westgate and the City. There are flour mills only in Northgate, Westgate and the City. I know the roads are not being repaired in the City, though they may be in the other places. Where has father been?

11. Where the climate is hot, aloes and rubber will grow: heather and grass will only grow where it is cold. Heather and rubber require plenty of moisture: grass and aloes will grow only in fairly dry regions. Near the river Amazon it is very hot and very damp. Which of the above grows there?

x x x x x x x x x x x x x x x x

12. Field-mice devour the honey stored by the bumble-bees: the honey which they store is the chief food of the bumble-bees. Near towns there are far more cats than in the open country. Cats kill all kinds of mice. Where, then, do you think there are most bumble-bees--near towns or in the open country?

13. I started from the church and walked 100 yards; I turned to the right and walked 50 yards; I turned to the right again and walked 100 yards. How far am I from the church?

x x x x x x x x x x x x x x x x

14. A pound of meat should roast for half-an-hour; two pounds of meat should roast for three-quarters of an hour; three pounds of meat should roast for one hour; eight pounds of meat should roast for two hours and a quarter; nine pounds of meat should roast for two hours and a half. From this can you discover a simple rule by which you can tell from the weight of a joint how long it should roast?

15. What conclusions can you draw from the following facts? Iron nails will not float in a pool; a cup of pure gold dust weighs nearly twenty times as much as a cup of water of the same size; if you drop a silver dime or a copper coin into a puddle, it will sink to

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[illegible]

[illegible]

the bottom; a cubic inch (about a tablespoonful) of water weighs less than half an ounce, a cubic inch of brass weighs over two ounces; a leaden weight will drop to the bottom of the ocean. Sum up all these observations in one short sentence of the following form: "Most --- are --- --- ---."

x x x x x x x x x x x x x x x x

16. John said: "I heard my clock strike yesterday ten minutes before the first gun fired. I did not count the strokes, but I am sure it struck more than once, and I think it struck an odd number." John was out all morning, and his clock stopped at five to five the same afternoon. When do you think the first gun fired?

17. Captain Watts and his son James have been found shot--the father in the chest, and the son in the back. Both clearly died instantaneously. A gun fired close to the person,--as; for example, when a man shoots himself--will blacken and even burn the skin or clothes; fired from a greater distance it will leave no such mark. The two bodies were found near the middle of a large hall used as a rifle range. Its floor is covered with damp sand, which shows every footprint distinctly. Inside the room there are two pairs of footprints only. A third man standing just outside would show no footmarks. Under Captain Watt's body was found a gun; no such weapon was found near James. In each case the coat, where the bullet entered, was blackened with gunpowder, and the cloth a little singed. Captain Watts was devoted to his son, and would have died sooner than harm him purposely; hence it is impossible to suppose that he killed him deliberately, even in self-defence. But some think that James secretly disliked his father, and hoped to inherit his fortune at his death. (1) Was Captain Watt's death due to murder, accident or suicide? (2) Was James' death due to murder, accident or suicide?

APPENDIX B

SCHOOL..... DATE.....

PROBLEM..... STUDENT..... RATER....

Examiner's Comments

The descriptions listed below apply to the work in various ways. Check those that apply clearly, A; not very clearly in column B. The negative aspects will also be checked, but encircled. If the statements do not apply, leave the space blank.

Appreciating the nature of the problem due to:	A	B
1. Understanding the directions	.....	.....
2. Clear knowledge of key words	.....	.....
3. Keeping in mind the key ideas	.....	.....
4. Visualizing or describing the problem	.....	.....
5. Knowledge of the necessary facts or rules	.....	.....
Method:		
1. Re-reading or restating the problem	.....	.....
2. Choosing the right process to solve	.....	.....
3. Breaking into smaller parts	.....	.....
4. Proceeding step by step, not trial and error	.....	.....
Attitude toward problem:		
1. Reaching the answer by logical steps	.....	.....
2. Reasoning the answer	.....	.....
3. Confidence due to previous success	.....	.....

Over all Rating	P.	B.F.	F.	G.	Ex.
	.....	.....	.....	.....	.....

Was the question solved correctly? .....

APPENDIX C

CLOVER BAR SCHOOL SURVEY

Under the Sponsorship of the Chairman and the Boara of Trustees of the Clover Bar School Division

STUDENT DATA ASSEMBLY SHEET

DIRECTION

Mr. L. A. Walker, Superintendent of Schools for the Clover Bar School Division.

Dr. H. Siemens, Medical Health Officer, Leduc-Strathcona Health Unit.

Mr. E. J. Kibblewhite, Welfare Officer, Leduc-Strathcona Health Unit.

Mr. J. A. MacDougall, Supervisor of Mental Hygiene for the Schools, Leduc-Strathcona Health Unit.

●

CONSULTANTS

Dr. G. M Dunlop, Chairman, Division of Educational Psychology, Faculty of Education, University of Alberta.

Dr. D. B. Black, Associate Professor, Division of Educational Psychology, Faculty of Education, University of Alberta.

CLOVER BAR SURVEY - 1958

Under the Sponsorship of the Board of the Clover Bar School Division Number 13

DO NOT MARK IN THIS COLUMN

No. .....

1 - 6

I. IDENTIFYING DATA:

1. Name: ..... (Surname) ..... (First Name and Initial) ..... Sex: M .....; F .....
2. Age: Years ..... Months ..... Grade .....
3. Home: Edmonton ..... Town or Village ..... Farm ..... 25. .....
4. (a) Ethnic Stock: 1. Birthplace ..... 26. .....
   2. Birthplace of Father ..... 27. .....
   3. Birthplace of Mother ..... 28. .....

   (b) Lauguage(s) spoken in home 1. ..... 2. ..... 29. .....

II. FAMILY:

1. Father living: Yes ..... No .....
2. Mother living: Yes ..... No ..... 30. .....
3. Both parents living in the home: Yes ..... No .....
4. If parents not living together check the following:

   (a) parent absent, Mother ..... Father .....

   (b) cause, deceased .....; divorced .....; separated .....; other..... 31. .....
5. Number of Brothers and Sisters .... 32. 33.
6. Are parents gainfully employed? Father Yes ..... No ..... 34. .....

   Mother Yes ..... No .....
7. Length of residence in locality: less than one year.....; 1 year .....; 2 years .....;

   3 years .....; 4 or more years ..... 35. .....
8. Ownership of home: Yes ..... No..... 36. .....
9. Ownership of car: Yes ..... No ..... 37. .....
10. Ownership of TV: Yes ..... No ..... 38. .....

DO NOT MARK IN THIS COLUMN

III. EDUCATIONAL:

1. Age at school entrance ....., ... ; (Years, Months) — 39. ..... 40. .....

2. Normal progress ..... ; — 41. .....

3. Retarded: Yes ..... 4. If so, how many years ..... — 42. .....

5. In what grade or grades? ..... — 43. ..... 44. .....

6. Accelerated: Yes ..... No ..... 7. If so, how many times ..... — 45. .....

8. In what grade or grades? ..... — 46. ..... 47. .....

9. How many times has the family moved from one school district or division to another during the child's school attendance ..... — 48. .....

10. Number of days absent from school since Sept. 1, 1957 ..... — 49. ..... 50. .....

IV. ECONOMIC:

1. Occupation of Father ..... (farmer, oil field worker, factory or industrial worker; teacher, manager, small proprietor, large proprietor; office worker, doctor, lawyer; engineer, other profession or occupation.) — 51. ..... 52. .....

.....

.....

(Describe the occupation clearly.)

2. Occupation of Mother ..... — 53. ..... 54. .....

3. Estimated family income: 0-2,999. .....; 3,000-4,999. .....; 5,000-6,999. .....; 7,000-9,999. .....; 10,000-up .....; — 55. .....

4. Work of Father: 1. in Edmonton .....; 2. Town or Village .....; 3. Farm ..... — 56. .....

5. Employer: (If father is not a proprietor) ..... — 57. .....

V. MEDICAL: (to be completed by the Health Unit)

1. Premature birth (birth weight below 5½ lbs.) Yes ..... No ..... — 58. .....

2. Congenital physical defect: Yes ..... No .....

If yes, type ..... — 59. .....

3. Allergies: eczema, asthma, hay fever (underline, if present) — 60. .....

4. Hearing loss: 15 decibels or more, both ears: Yes ..... No ..... — 61. .....

If yes, has it been corrected? Yes ..... No .....

DO NOT MARK IN THIS COLUMN

5. Visual defect: Yes..... No..... Corrected .....

If yes—below 20/40 in one or both eyes; Yes ..... No ..... 62. .....

above 20/40 in one or both eyes; Yes ..... No .....

6. Tuberculin Test: Negative ..... Positive ..... 63. .....

7. Enuresis: Twice a week or oftener after 4 years of age:

Yes ..... No ..... 64. .....

8. Did child stammer or stutter seriously at any time during attendance at school? Yes .....

No ..... 65. .....

VI. BEHAVIOUR: (please indicate rating by check mark)

Type	Negligible	Slight	Average	Above Average	Very Marked	
Social participation						66.
Aggressiveness						67.
Honesty						68.
Truthfulness						69.
Cooperativeness						70.
Emotional stability						71.

APPENDIX D

TABLE I

FIRST ORDER PARTIAL CORRELATION COEFFICIENTS OF ORAL DOMINANCE AND OTHER TEST VARIABLES WITH EACH OF THE REMAINING VARIABLES HELD CONSTANT, ONE AT A TIME (N=265)

(Corresponding zero order correlations are placed at the top of the tables.)

		C.A.	M.A.	I.Q.	V	Q	T	Ma.	Sc.	S.S.	W	L	E	R	O	W
	Held	-.06	.03	.09	.03	-.01	.00	.05	-.01	-.00	-.03	.06	.01	-.03	.49	-.43
	Con-stant	$r_{1.14}$	$r_{2.14}$	$r_{3.14}$	$r_{4.14}$	$r_{5.14}$	$r_{6.14}$	$r_{7.14}$	$r_{8.14}$	$r_{9.14}$	$r_{10.14}$	$r_{11.14}$	$r_{12.14}$	$r_{13.14}$	$r_{15.14}$	$r_{16.14}$*
1	C.A.	----	.03	.07	.03	.01	.01	.06	-.01	.01	-.03	-.07	.01	-.03	.49	-.43
2	M.A.	-.06	----	.11	.01	-.04	-.04	.04	-.05	-.02	-.07	-.10	-.01	-.07	.55	-.51
3	I.Q.	.02	-.08	----	-.03	-.05	-.06	.00	-.08	-.05	-.10	-.12	-.03	-.10	.50	-.50
4	"V"	-.06	.01	.09	----	-.03	-.05	-.04	-.05	-.03	-.07	-.11	-.00	-.08	.55	-.51
5	"Q"	-.06	.05	.09	.03	----	.02	.09	-.02	.01	-.03	-.07	.01	-.03	.55	-.49
6	"T"	-.06	.05	.11	.06	-.02	----	.08	-.02	-.00	-.04	-.08	.01	-.05	.58	-.52
7	Ma.	-.07	.01	.07	-.00	-.07	-.06	----	-.07	-.05	-.09	-.11	-.01	-.09	.55	-.55
8	Sci.	-.06	.05	.10	.06	-.00	.01	.09	----	.01	-.04	-.08	.01	-.04	.57	-.51
9	S.S.	-.06	.04	.10	.04	-.01	.00	.07	-.02	----	-.04	-.08	.01	-.04	.58	-.52
10	W	-.06	.07	.13	.07	.01	.03	.10	-.02	.03	----	-.06	.03	-.01	.54	-.48
11	L	-.05	-.01	.07	-.01	-.05	-.05	.01	-.08	-.05	-.09	----	-.02	-.09	.54	-.60
12	E	-.06	.03	.09	.03	-.01	-.00	.05	-.02	-.00	-.04	-.07	----	-.04	.50	-.45
13	R	-.06	.07	.13	.01	.01	.03	.10	.02	.03	-.01	-.05	.03	----	.58	-.49
14	O-W	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
15	O	-.07	-.28	-.16	-.29	-.30	-.35	-.30	-.34	-.35	-.28	-.44	-.14	-.31	----	.96
16	W	-.03	.23	.30	.31	.26	.32	.38	.30	.32	.23	.29	.14	.27	.96	----

*$r_{1.14}$, $r_{2.14}$, etc. are used to represent $r_{1.(14)}$, $r_{2.(14)}$, etc.

TABLE 2

Pilot test ratios, correlation coefficients of each factor with the criterion, and number of variables with loads in the rotated factor matrix, for 1-, 2-, and 3-factor (Lawley)

(corresponding data other correlations are placed at the top of the table)

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible], [illegible], and the data is regressed [illegible], [illegible], and.

TABLE II

FIRST ORDER PARTIAL CORRELATION COEFFICIENTS OF ORAL SCORES AND OTHER TEST VARIABLES WITH EACH OF THE REMAINING VARIABLES HELD CONSTANT, ONE AT A TIME (N=265)

		C.A.	M.Q.	I.Q.	V	Q	T	Math.	Sci.	S.S.	W	L	E	R	O-W	W
	Held Constant	.01	.49	.44	.51	.45	.53	.55	.50	.53	.45	.54	.26	.48	.49	.55
		$r_{1.15}$	$r_{2.15}$	$r_{3.15}$	$r_{4.15}$	$r_{5.15}$	$r_{6.15}$	$r_{7.15}$	$r_{8.15}$	$r_{9.15}$	$r_{10.15}$	$r_{11.15}$	$r_{12.15}$	$r_{13.15}$	$r_{14.15}$	$r_{16.15}$
1	C.A.	----	.49	.50	.51	.47	.54	.56	.50	.53	.45	.54	.26	.48	.49	.55
2	M.A.	-.03	----	.08	.22	.19	.27	.33	.24	.33	.17	.35	.03	.22	.55	.41
3	I.Q.	.25	.25	----	.25	.33	.39	.41	.33	.40	.29	.42	.09	.31	.50	.46
4	"V"	-.01	.21	.20	----	.22	.21	.34	.21	.29	.16	.31	.04	.16	.55	.40
5	"Q"	-.15	.29	.32	.35	----	.32	.36	.31	.36	.23	.39	.11	.29	.56	.43
6	"T"	-.12	.15	.22	.13	-.09	----	.25	.18	.25	.10	.30	.04	.14	.58	.36
7	Math.	-.01	.16	.20	.25	.06	.19	----	.16	.25	.12	.28	.07	.16	.55	.36
8	Sci.	-.03	.22	.22	.23	.19	.30	.30	----	.27	.13	.30	.03	.09	.57	.38
9	S.S.	-.04	.24	.24	.23	.18	.25	.31	.18	----	.16	.30	.08	.17	.58	.36
10	W.	-.02	.27	.25	.31	.23	.33	.39	.28	.35	----	.37	.06	.23	.53	.42
11	L.	-.05	.25	.25	.24	.22	.27	.31	.19	.27	.15	----	.05	.19	.54	.33
12	E.	-.00	.49	.38	.46	.39	.48	.51	.44	.49	.40	.49	----	.43	.51	.52
13	R.	-.03	.24	.23	.25	.21	.29	.34	.23	.32	.13	.34	.06	----	.58	.40
14	O-W	.05	.55	.45	.58	.52	.61	.60	.57	.61	.53	.59	.29	.53	----	.97
15	O	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
16	W	-.03	.30	.30	.33	.25	.32	.35	.29	.32	.24	.30	.14	.26	.96	----

TABLE II

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE III

FIRST ORDER PARTIAL CORRELATION COEFFICIENTS OF WRITTEN SCORES AND OTHER TEST VARIABLES WITH EACH OF THE REMAINING VARIABLES HELD CONSTANT, ONE AT A TIME (N=265)

		C.A.	M.A.	I.Q.	V	Q	T	Math.	Sci.	S.S.	W	L	E	R	O-W	O
	Held Constant	.07	.49	.38	.50	.49	.56	.55	.55	.56	.50	.62	.27	.54	-.43	.55
		$r_{1.16}$	$r_{2.16}$	$r_{3.16}$	$r_{4.16}$	$r_{5.16}$	$r_{6.16}$	$r_{7.16}$	$r_{8.16}$	$r_{9.16}$	$r_{10.16}$	$r_{11.16}$	$r_{12.16}$	$r_{13.16}$	$r_{14.16}$	$r_{15.16}$
1	C.A.	----	.48	.47	.50	.49	.56	.55	.55	.56	.50	.62	.27	.54	-.43	.55
2	M.A.	.04	----	-.04	.25	.25	.33	.33	.33	.37	.25	.47	.05	.32	-.51	.41
3	I.Q.	.30	.33	----	.37	.40	.45	.44	.44	.46	.37	.53	.13	.42	-.50	.46
4	"V"	.06	.23	.12	----	.28	.29	.34	.30	.34	.25	.44	.06	.28	-.51	.40
5	"Q"	-.09	.26	.23	.30	----	.32	.33	.35	.38	.27	.48	.10	.34	-.49	.43
6	"T"	-.06	.11	.11	.06	-.06	----	.20	.24	.27	.16	.40	.03	.21	-.52	.36
7	Math.	-.04	.16	.12	.23	.13	.24	----	.25	.30	.20	.41	.08	.26	-.55	.35
8	Sci.	-.04	.16	.09	.16	.21	.27	.25	----	.27	.16	.37	.02	.20	-.51	.38
9	S.S.	.02	.21	.15	.19	.22	.27	.28	.24	----	.21	.40	.08	.25	-.52	.36
10	W.	.04	.22	.14	.25	.25	.33	.33	.30	.36	----	.45	.04	.27	-.48	.42
11	L.	.01	.17	.12	.15	.23	.25	.24	.19	.25	.29	----	.02	.22	-.60	.33
12	E.	.08	.43	.31	.44	.43	.51	.50	.50	.52	.44	.58	----	.49	-.45	.52
13	R.	.03	.18	.10	.16	.23	.27	.28	.24	.30	.14	.41	.04	----	-.49	.39
14	O-W	.05	.56	.46	.57	.54	.62	.63	.61	.62	.54	.72	.30	.56	----	.97
15	O	.08	.30	.18	.30	.32	.38	.35	.36	.38	.34	.46	.16	.37	.96	----
16	W	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

TABLE [illegible]

[illegible] MEANS AND STANDARD DEVIATIONS OF RATINGS OF [illegible] ON THE [illegible] (N=[illegible])

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE IV

FIRST ORDER PARTIAL CORRELATION COEFFICIENTS OF ORAL DOMINANCE AND OTHER TEST VARIABLES WITH EACH OF THE REMAINING VARIABLES HELD CONSTANT, ONE AT A TIME, FOR FEMALE SCORES (N=137)

		C.A.	M.A.	I.Q.	V	Q	T	Math.	Sci.	S.S.	W	L	E	R	O	W
	Held Constant	-.07	-.07	-.03	-.06	-.06	-.06	-.09	-.21	-.06	-.16	-.13	-.09	-.13	.43	-.50
		$r_{1.14}$	$r_{2.14}$	$r_{3.14}$	$r_{4.14}$	$r_{5.14}$	$r_{6.14}$	$r_{7.14}$	$r_{8.14}$	$r_{9.14}$	$r_{10.14}$	$r_{11.14}$	$r_{12.14}$	$r_{13.14}$	$r_{15.14}$	$r_{16.14}$
1	C.A.	----	-.07	-.00	-.06	-.05	-.05	-.08	-.20	-.05	-.15	-.12	-.09	-.12	.43	-.50
2	M.A.	-.07	----	.16	-.02	-.02	-.01	-.06	-.24	-.02	-.16	-.11	-.07	-.10	.53	-.54
3	I.Q.	-.06	-.18	----	-.10	-.08	-.09	-.13	-.28	-.08	-.21	-.17	-.11	-.17	.47	-.56
4	"V"	-.07	-.04	.08	----	-.03	-.02	-.07	-.25	-.03	-.17	-.12	-.07	-.12	.51	-.54
5	"Q"	-.06	-.04	.06	-.05	----	-.01	-.07	-.23	-.03	-.16	-.11	-.07	-.12	.51	-.54
6	"T"	-.06	-.04	.07	-.02	-.01	----	-.07	-.25	-.02	-.17	-.12	-.07	-.12	.54	-.55
7	Math.	-.06	-.01	.09	-.01	.01	.02	----	-.21	.00	-.14	-.09	-.06	-.09	.54	-.54
8	Sci.	-.06	.13	.19	.16	.10	.16	.09	----	.14	-.01	.03	-.00	.04	.58	-.48
9	S.S.	-.06	-.04	.07	-.03	-.03	-.02	-.07	-.25	----	-.16	-.12	-.08	-.12	.51	-.54
10	W.	-.05	.07	.14	.07	.06	.09	.03	-.15	.06	----	-.04	-.03	-.01	.54	-.49
11	L.	-.06	.02	.11	.04	.01	.03	-.01	-.17	.03	-.10	----	-.04	-.06	.57	-.53
12	E.	-.07	-.03	.07	-.03	-.03	-.03	-.07	-.19	-.04	-.13	-.10	----	-.11	.47	-.50
13	R.	-.06	.02	.11	-.02	.02	.04	-.01	-.17	.04	-.09	-.06	-.05	----	.52	-.50
15	O	-.07	-.36	-.22	-.31	-.31	-.38	-.38	-.48	-.32	-.40	-.44	-.23	-.36	----	-.99
16	W	-.05	.26	.31	.23	.23	.30	.25	.12	.25	.14	.24	.09	.16	.98	----

TABLE V

FIRST ORDER PARTIAL CORRELATION COEFFICIENTS OF ORAL DOMINANCE AND OTHER TEST VARIABLES WITH EACH OF THE REMAINING VARIABLES HELD CONSTANT, ONE AT A TIME, FOR MALE SCORES (N=128)

		C.A.	M.A.	I.Q.	V	Q	T	Math.	Sci.	S.S.	W	L	E	R	O	W
	Held	-.05	.16	.17	.13	.05	.08	.17	.15	.04	.13	.02	.13	.07	.54	-.36
	Con-stant	$r_{1.14}$	$r_{2.14}$	$r_{3.14}$	$r_{4.14}$	$r_{5.14}$	$r_{6.14}$	$r_{7.14}$	$r_{8.14}$	$r_{9.14}$	$r_{10.14}$	$r_{11.14}$	$r_{12.14}$	$r_{13.14}$	$r_{15.14}$	$r_{16.14}$
1	C.A.	----	.17	.17	.13	.07	.09	.18	.15	.04	.13	.03	.13	.08	.54	-.36
2	M.A.	-.07	----	.09	.02	-.07	-.07	.08	.06	-.09	.03	-.08	.06	-.08	.53	-.48
3	I.Q.	.03	.04	----	.04	-.01	-.01	.10	.06	-.06	.04	-.05	.07	-.05	.52	-.44
4	"V"	-.06	.09	.12	----	-.04	-.07	.11	.08	-.07	.05	-.08	.07	-.06	.56	-.50
5	"Q"	-.07	.17	.16	.13	----	.08	.20	.15	.01	.13	-.01	.12	.05	.59	-.44
6	"T"	-.07	.15	.15	.13	-.05	----	.17	.14	-.03	.11	-.05	.10	.01	.63	-.49
7	Math.	-.08	.06	.10	.02	-.11	-.08	----	.04	-.10	.02	-.13	.08	-.08	.57	-.53
8	Sci.	-.06	.08	.10	.03	-.06	-.05	.09	----	-.11	.02	-.13	.07	-.08	.56	-.52
9	S.S.	-.05	.18	.18	.15	.03	.08	.20	.18	----	.14	-.01	.12	.06	.63	-.48
10	W.	-.06	.10	.12	.05	-.04	-.02	.11	.08	.07	----	-.08	.08	-.05	.56	-.49
11	L.	-.05	.18	.18	.15	.05	.09	.22	.19	.04	.15	----	.13	.08	.65	-.49
12	E.	-.06	.11	.13	.07	-.00	.02	.13	.10	-.01	.05	-.04	----	.01	.53	-.40
13	R.	-.06	.17	.16	.12	.01	.04	.18	.16	-.02	.12	-.04	.11	----	.62	-.49
15	O	-.07	-.16	-.08	-.25	-.27	-.33	-.25	-.25	-.42	-.24	-.44	-.03	-.37	----	-.94
16	W	.02	.39	.32	.40	.28	.38	.47	.43	.35	.37	.36	.23	.37	.95	----

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE VI

FIRST ORDER PARTIAL CORRELATION COEFFICIENTS OF ORAL SCORES AND OTHER TEST VARIABLES WITH EACH OF THE REMAINING VARIABLES HELD CONSTANT, ONE AT A TIME, FOR FEMALE SCORES (N=137)

		C.A.	M.A.	I.Q.	V	Q	T	Math.	Sci.	S.S.	W	L	E	R	O-W	W
	Held Constant	-.01	.49	.47	.44	.44	.51	.48	.41	.46	.40	.49	.25	.39	.43	.56
		$r_{1.15}$	$r_{2.15}$	$r_{3.15}$	$r_{4.15}$	$r_{5.15}$	$r_{6.15}$	$r_{7.15}$	$r_{8.15}$	$r_{9.15}$	$r_{10.15}$	$r_{11.15}$	$r_{12.15}$	$r_{13.15}$	$r_{14.15}$	$r_{16.15}$
1	C.A.	----	.49	.47	.44	.46	.52	.49	.41	.47	.41	.49	.25	.39	.43	.56
2	M.A.	-.03	----	.13	.17	.15	.25	.21	.08	.23	.07	.25	.05	.11	.53	.47
3	I.Q.	.27	.28	----	.24	.30	.36	.31	.18	.31	.20	.33	.08	.20	.47	.45
4	"V"	-.03	.29	.29	----	.31	.29	.30	.12	.25	.15	.29	.12	.29	.51	.44
5	"Q"	-.15	.29	.35	.26	----	.30	.25	.18	.26	.16	.35	.13	.18	.51	.44
6	"T"	-.15	.19	.27	.05	.09	----	.15	.03	.14	.03	.24	.09	.05	.54	.39
7	Math.	-.10	.23	.28	.22	.13	.25	----	.10	.21	.10	.28	.09	.13	.54	.41
8	Sci.	-.05	.30	.31	.21	.25	.34	.29	----	.26	.16	.31	.10	.13	.57	.43
9	S.S.	-.07	.30	.32	.20	.21	.28	.26	.12	----	.14	.28	.14	.12	.51	.43
10	W.	-.07	.31	.33	.25	.25	.34	.31	.19	.28	----	.33	.11	.14	.54	.45
11	L.	-.07	.25	.29	.16	.26	.29	.26	.11	.21	.13	----	.08	.11	.57	.39
12	E.	-.01	.44	.42	.39	.39	.47	.43	.35	.42	.34	.44	----	.34	.48	.52
13	R.	-.04	.34	.34	.37	.29	.36	.33	.19	.29	.17	.34	.14	----	.53	.44
14	O-W	.02	.58	.51	.52	.52	.60	.58	.57	.54	.52	.61	.32	.50	----	.99
16	W	-.05	.27	.31	.23	.23	.29	.25	.12	.25	.15	.24	.09	.15	.99	----

TABLE XI

MOST SIMPLE PARTIAL CORRELATION COEFFICIENTS OF THE GROUP OF TEST SCORES WITH CRITERIA WITH ALL OF THE CONCEPTUAL VARIABLES INCLUDED, ONE AT A TIME, THE VARIABLE SCORES (N=177)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	----	.00	.75	.80	.14	.18	.99	.18	.74	.00	.00	.49	.77	.90	.00	.00
2	.00	----	.11	.00	.78	.70	.00	.00	.18	.00	.11	.72	.11	.00	.47	.77
3	.75	.11	----	.00	.00	.00	.00	.18	.00	.00	.00	.00	.00	.00	.00	.00
4	.80	.00	.00	----	.00	.11	.00	.11	.00	.00	.14	.00	.00	.00	.00	.11
5	.14	.78	.00	.00	----	.11	.00	.11	.00	.00	.00	.00	.00	.00	.00	.11
6	.18	.70	.00	.11	.11	----	.00	.00	.11	.00	.00	.00	.00	.00	.00	.00
7	.99	.00	.00	.00	.00	.00	----	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.18	.00	.18	.11	.11	.00	.00	----	.00	.00	.00	.00	.00	.00	.00	.00
9	.74	.00	.00	.00	.00	.11	.00	.00	----	.00	.00	.00	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00	.00	.00	.00	.00
11	.00	.11	.00	.14	.00	.00	.00	.00	.00	.00	----	.00	.00	.00	.00	.00
12	.49	.72	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00	.00	.00
13	.77	.11	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00	.00
14	.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00
15	.00	.47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00
16	.00	.77	.00	.11	.11	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----

TABLE VII

FIRST ORDER PARTIAL CORRELATION COEFFICIENTS OF ORAL SCORES AND OTHER TEST VARIABLES WITH EACH OF THE REMAINING VARIABLES HELD CONSTANT, ONE AT A TIME, FOR MALE SCORES (N=128)

		C.A.	M.A.	I.Q.	V	Q	T	Math.	Sci.	S.S.	W	L	E	R	O-W	W
	Held	.02	.51	.43	.57	.48	.57	.62	.58	.58	.55	.59	.29	.58	.54	.55
	Constant	$r_{1.15}$	$r_{2.15}$	$r_{3.15}$	$r_{4.15}$	$r_{5.15}$	$r_{6.15}$	$r_{7.15}$	$r_{8.15}$	$r_{9.15}$	$r_{10.15}$	$r_{11.15}$	$r_{12.15}$	$r_{13.15}$	$r_{14.15}$	$r_{16.15}$
1	C.A.	----	.51	.50	.57	.50	.58	.63	.58	.58	.55	.59	.29	.58	.54	.55
2	M.A.	-.06	----	.04	.34	.23	.32	.43	.37	.37	.33	.43	.05	.28	.53	.42
3	I.Q.	.28	.31	----	.43	.39	.44	.51	.45	.46	.41	.50	.14	.45	.52	.49
4	"V"	-.01	.17	.14	----	.20	.18	.39	.29	.31	.25	.36	-.03	.25	.57	.36
5	"Q"	-.17	.30	.32	.39	----	.35	.45	.41	.41	.37	.44	.12	.40	.56	.41
6	"T"	-.12	.14	.18	.18	-.09	----	.34	.28	.29	.24	.34	-.00	.25	.60	.34
7	Math.	-.13	.13	.16	.27	.02	.17	----	.21	.28	.23	.29	.09	.23	.56	.32
8	Sci.	-.02	.19	.15	.27	.19	.26	.34	----	.27	.20	.31	.02	.25	.57	.36
9	S.S.	-.02	.21	.19	.28	.19	.27	.38	.27	----	.26	.33	.07	.27	.64	.31
10	W.	-.00	.23	.18	.30	.22	.29	.41	.29	.33	----	.37	.04	.29	.56	.39
11	L.	-.06	.27	.25	.31	.21	.29	.37	.28	.30	.25	----	.06	.29	.65	.27
12	E.	.00	.43	.36	.51	.41	.51	.58	.52	.53	.49	.54	----	.52	.53	.52
13	R.	-.05	.12	.11	.22	.17	.21	.35	.25	.27	.19	.32	.02	----	.62	.32
14	O-W	.06	.51	.41	.60	.54	.63	.64	.60	.66	.58	.69	.26	.65	----	.95
16	W	-.03	.36	.32	.40	.29	.37	.45	.41	.37	.39	.36	.21	.38	.95	----

0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00
2	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00	.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	----	.00	.00	.00	.00	.00	.00	.00	.00
9	.00	.00	.00	.00	.00	.00	.00	----	.00	.00	.00	.00	.00	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	----	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	----	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	----	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	----	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	----	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	----	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	θ_0	θ_1	θ_2	θ_3	θ_4	θ_5	θ_6	θ_7	θ_8	θ_9	θ_{10}	θ_{11}	θ_{12}	θ_{13}	θ_{14}	θ_{15}	θ_{16}
θ_{17}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{18}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{19}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{20}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{21}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{22}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{23}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{24}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{25}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{26}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{27}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{28}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{29}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{30}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{31}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{32}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{33}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{34}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
θ_{35}	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

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